Saskatchewan
Agriculture
and Food

ADF

AGRICULTURE DEVELOPMENT FUND

FINAL REPORT

20010212

GENE FLOW IN SPRING WHEAT AT THE COMMERCIAL SCALE

Funded by: The Agriculture Development Fund

March 2007

Prepared by: University of Saskatchewan

ADF PROJECT # 20010212
"GENE-MOVEMENT IN SPRING WHEAT AT THE COMMERCIAL SCALE"

Final Report
May 1, 2002 to December 31, 2006

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ABSTRACT

To date, information on gene flow in spring wheat at distances greater than 300 meters has been scarce. The objective of this project was to measure gene flow rates using a seed color marker. In each of two years, neighboring fields were sampled at maturity within a 10 km radius of the pollen donor. In 2002, one case of gene flow was confirmed at 190 m. In 2003, nine putative hybrid seeds were identified. Gene flow was detected at 500 m NE, 630 m SE, and 2.75 km NW from the pollinator. Thus, in this study, gene flow in wheat occurred at trace levels ($\leq$0.01%) at distances of up to 2.75 km in commercial fields. The 76 recipient fields and donor field were surveyed for blue aleurone volunteers three years post-harvest. A single putative volunteer plant was detected in the 2003 donor field seeded to wheat in 2006.

INTRODUCTION

Background Information

When this project was initiated, the first transgenic wheat (*Triticum aestivum* L.) cultivar was predicted to enter commercial production in Canada by the year 2004 or 2005. This impending release left the wheat industry with a number of questions regarding intra-specific as well as inter-specific & inter-generic gene-flow. For instance, how far will transgenic wheat have to be isolated from neighboring non-GM-fields to completely eliminate movement of the trans-gene? Research assessing the gene movement rate of wheat under large-scale field studies is currently unavailable.

Rieger et al. (2002) reported that pollen-mediated flow of herbicide resistance between commercial canola (*Brassica napus*) fields using 63 large commercial scale pollen fields (25 to 100 ha) remained below 1%, but constant, at distances up to 3 km. Wheat is predominantly a self-pollinating crop with a gene flow rate of usually less than 1% (Johnson and Schmidt, 1968). Successful gene flow in wheat not only depends upon the receptivity of the stigmas, the viability of the pollen, and availability of pollen during the receptive period (Johnson and Schmidt, 1968; Waines and Hegde, 2003), but these factors vary with genotype and the environment (de Vries, 1971, 1972, 1974; Waines and Hegde, 2003). In general, research has indicated that low male fertility is generally associated with cultivars possessing higher gene flow rates (Hucl, 1996; Hucl and Matus-Cádiz, 2001).

We have reported intra-specific hybridization at a distance of approximately 300-m (Matus-Cádiz, Hucl et al, 2004). Sampling did not extend beyond 2-km and it is possible that low levels of cross-pollination occur beyond that distance. The study by Matus-Cádiz, Hucl et al (2004) was based on a pollen source 50x50 m (1/2 acre) in size. Hanson et al. (2005) reported pollen-mediated gene flow rates generally below 0.02% by 42 m in wheat when grown adjacent to a 46 m diameter (0.16 ha) central blue-grained winter wheat pollinator. Consequently, commercial-scale field studies are needed to determine at what frequency gene-flow can occur. We proposed to study gene-flow in wheat using the blue aleurone trait, a dominant gene marker, in pigmented

common wheat. Gene flow can be identified by the expression of light-blue pigmentation in the aleurone layer of the F_1 hybrid seed.

The objectives of this project were: 1) to assess the level of pollen-mediated gene-flow from blue aleurone spring wheat (*T. aestivum L.* Purendo-38) to wheat cultivars (*T. aestivum*) grown in adjacent fields over long distances (0 to 10-km) from a pollinator field and 2) to quantify the levels of blue aleurone wheat in target fields in subsequent crops (up to three years).

METHODS AND RESULTS

METHODS

1. Gene flow estimation

Seed of Purendo-38, a spring type blue-aleuroned wheat (Abdel-Aal and Hucl, 1999; Matus-Cádiz et al., 2004) was obtained from the Crop Development Center, Saskatoon, SK. In 2001, seed of Purendo-38, was increased by the Crop Development Centre, Saskatoon, SK for use in 2002 and 2003. Purendo-38 was seeded as a 33 ha (2002) and 20 ha (2003) field approximately 200 km east-northeast of Saskatoon, in an area spanning two RM's. Standard agronomic practices for growing spring wheat were used within the central pollinator and neighboring fields. Purendo-38 was seeded on 24 May in 2002 and 19 May in 2003 at a low rate (100 seeds/m^2), with rows spaced 0.2 m apart. The reduced seeding rate of the pollinator field was used to promote tillering and thereby extend the period of pollen shedding. The central Purendo-38 field sown in 2003 was located 4.8 km south of the pollinator field established in 2002. In 2003, the 2002 Purendo-38 field was seeded to peas (*Pisum sativum*) and no wheat volunteers were found within the 33 ha area during the flowering period of the 2003 Purendo-38 block. Duration of flowering (days between the first & last observed occurrence of anthesis) was collected for the pollinator field. Presence or absence of flowering was collected for each recipient wheat field during the pollination period of Purendo-38. Average size of recipient fields in both years was 65 ha. Meteorological data were collected within 60 km of the pollinator fields by Environment Canada (Table 1).

In 2002, a total of 76 recipient fields were used, with 28 fields at a distance of 0 to 5.00-km and 48 fields at a distance of >5.00 to 10-km from the pollinator field. A distance of 0 to 5-km was proposed in the original proposal. This distance was expanded to 0 to 10-km during the summer of 2002 because the number of wheat fields within 0 to 5-km of the pollinator field was deemed inadequate for a large-scale study. In 2003, a total of 76 recipient fields were used, with 34 fields at a distance of 0 to 5.00-km and 42 fields at a distance of >5.00 to 10-km from the pollinator field.

In 2002 and 2003, wheat fields grown at varying distances (0 to 10 km) and directions from the Purendo-38 field were sampled. Four samples were sickled and bagged from each corner of each recipient wheat field. In 2002 samples consisted of 2 x 2-m quadrats while in 2003 samples consisted of 1 x 1-m quadrants. Samples size was increased in 2002 from 1 x 1-m to 2 x 2-m quadrants because of the thinner than normal plant stands observed in 2002 (due to drought conditions). Bagged samples were dried overnight on forced-air driers.

In 2002, 100 spikes from each sample were individually threshed and visually inspected for the presence of fully blue-aleurone seed (all blue seed or a 3 blue: 1 non-blue seed ratio). This was done to determine if blue aleurone plants were present in the target fields. None of the spikes inspected in 2002 were fully blue-grained or segregating for blue-grain color. Thus, there is no evidence of pre-existing blue aleuroned plants in the target fields. In 2003, 300 spikes from each sample were individually threshed and visually inspected. As in 2002, there was no evidence of blue-aleurone seed in the 90,000 or so spikes examined for grain color.

Common wheat samples were threshed using a small plot combine. Durum wheat samples were threshed using a rubber-belted de-awner. The wind-speed on the de-awner was turned off to retain shriveled seed; and consequently, chaff within samples was removed manually. Samples were sorted before threshing based on quadrant (NE, SE, SW, and NW) and distance (0 to 10-km). Samples harvested from the NE quadrant were threshed in descending order based on distance, samples harvested from the SE quadrant were threshed in descending order based on distance, and so on until all samples were threshed. A 2 x 2-m quadrat sample of barley (*Hordeum vulgare* L.) was used to clean the combine or belt thresher after the last sample from each quadrat had been threshed. All the seeds from each sample were counted using an ESC-1 electronic seed counter.

Cross-pollination from Purendo-38 to target wheat plants was identified by the expression of a light-blue pigment in the aleurone layer of the F_1 hybrid seed. In both years of the study, all samples were visually screened for putative light blue seeds (data not presented) using the following procedure. In 2002, seed samples were placed in 2-lb mesh bags and soaked overnight in water. Pre-soaking enhances the expression of the light blue grain color. In 2002 the grain quality was of a poor quality due to weathering and staining. In 2003, the grain appearance was excellent and pre-soaking was not required to enhance grain color. Putative light blue seeds were grown out under controlled growth conditions to produce progeny plants in order to confirm visual identifications. Seeds were pre-germinated at 15°C (in darkness) for 2-d in a petri-dish (each containing a Whatman No.1 filter paper) before transferring to potting mix. Seeds were inspected for blue pigmentation at this point in 2003. Pre-germinated seeds were planted (1-cm depth) in 15-cm diameter pots (maximum of seven plants per pot). Pots were filled with Terra-Lite Redi-Earth (W.R. Grace and Co. of Canada Ltd. Ajax, ON). In 2003 growth cabinet conditions were set to 24/18°C (day/night) with 18-h light and a photosynthetically active radiation level of 400 $\mu mol\ m^{-2}\ s^{-1}$. Plants were watered every 4-d and fertilized using Type 100 Nutricote controlled release granular fertilizer (14-14-14) (Plant Products Co. Ltd. Brampton, ON) at a rate of 0.8-kg m^{-2}. Plants were allowed to self-pollinate and segregation among F_1-derived F_2 seed was classified as segregating (3 blue: 1 non-blue seed ratio) or non-segregating (all non-blue seeds) for the blue-aleurone trait. Gene movement rates were calculated as follows: gene movement (%) = (No. of confirmed light blue seeds observed in s_i at d_j/total No. of seeds screened in s_i at d_j) x 100 where s_i is the i th sample and d_j is the j th distance.

In 2003, F_1-derived F_2 seed was harvested from each confirmed hybrid plant and subsequently, 96 F_2 seeds (48 blue-aleurone and 48 non-blue) were grown out from each hybrid plant to maturity using the growth conditions described above. Each of the established F2 plants were phenotyped for spike morphology, kernel shape, and seed color. Purendo-38, AC Splendor, and

HR5500 are tip-awned while AC Taber is awned. For each of nine hybrid plants, five F_2-derived F_3 seeds from four F2 plants were advanced for gliadin fingerprinting. Only the putative hybrid seeds detected in 2003 were tested using gliadin fingerprinting as only these nine outcrossing events were at distances (>300 m) previously unreported in the literature (Matus-Cádiz et al., 2004).

Gliadin protein fingerprinting using A-PAGE was used to verify that the nine F_1 hybrid seeds detected in 2003 were from an outcrossing event resulting from pollination of recipient fields by Purendo-38. The Variety Identification Monitoring unit of the Grain Research Laboratory, Winnipeg, MB performed A-PAGE gliadin analysis using the International Standardization Organization (ISO) Method 8981:1993 (International Standardization Organization, 1993) with minor modifications. Single kernels were individually crushed and extracted overnight in 200 μL of 70% ethanol (v/v). Approximately 100 μL of sample dilution buffer (120% [w/v] sucrose dissolved in 50 ml of 8.5 m*M* aluminum lactate buffer, pH 3.1) was added to the ethanolic extract and vortexed. Extracts (3 μl) of single seeds were loaded onto 6% A-PAGE gels (1.5 mm x 8 cm x 18 cm) and run at constant current (90 mA) for 65 min in vertical slab electrophoresis units (GE Healthcare, Baie d'Urfé, QC). After completion of the runs, gels were removed and stained overnight in a solution of Coommassie Brilliant Blue R-250, ethanol and tricholoracetic acid. Breeder seed of AC Splendor, AC Taber, or HR5500 were run on each gel alongside Purendo-38 and 15 to 30 F3 seeds per hybrid plant to confirm hybridity. Breeder seed of AC Splendor, AC Taber, and HR5500 were run against samples collected from recipient fields #1, 22, and 49 to verify that the fields were in fact AC Splendor, HR5500, and AC Taber, respectively. The electrophoretic patterns obtained from each seed were compared to seed of Purendo-38 and AC Splendor, HR5500, and AC Taber. Major banding patterns in the omega (ω), gamma (γ), and alpha (α) gliadin regions, and occasionally the beta (β) gliadin region, were identified and recorded to confirm hybridity in F2-derived F3 seed.

2. Volunteer wheat surveying

Field sampling was conducted regardless of the crop in the rotation post pollen-outflow. For non-wheat fields volunteer counts (number of plants per quadrat) were made in-situ once the crops had headed out. If wheat plants were observed at maturity they were harvested and returned to our lab.

In fields sown to wheat, at maturity, the four corners of each field were sampled by sickling and bagging wheat plants from a 1 x 1-m quadrat. Bagged samples were dried overnight on forced-air driers and stored until further processing. The spikes were cut from the wheat stems and threshed individually using a rubber-belted de-awner. The seed from each spike was examined individually for the presence of the blue aleurone trait. The seed threshed from each quadrat was subsequently bulked (if no blue aleurone seed was observed) and weighed. The thousand kernel weight was determined for each sample. The total seed numbers per sample were estimated by dividing the total sample weight by the kernel weight.

RESULTS

The meteorological conditions during the 7 to 9 days of potential cross pollination in 2002 and 2003 are summarized in Table 1.

2002 Experiment

In 2002, the estimated duration of flowering was 7 days for Purendo-38 (5% anthesis on 14 July to 95% on 20 July). The estimated over-lap in pollination periods between the Purendo-38 pollinator field and recipient fields varied from one to 7 days (Table 2). This duration of pollination indicates that some level of nicking was expected between all recipient fields and the pollinator field. The period of over-lap in this study may be a conservative estimate as the stigma of male-fertile plants are known to be receptive for a period of four to 13 days (de Vries, 1971). Prevailing winds were from the S for 2 days (averaging 21 km hour^{-1}), NW or N for 2 days (averaging 13 km h^{-1}), ENE for 2 days (averaging 15 km hour^{-1}), and W for 1 day (averaging 15 km hour^{-1}) of pollination (Table 1). Prevailing wind direction is expected to be associated with elevated OC rates. Mean wind speed during pollination was 16 km hour^{-1} (range=12 to 26 km hour^{-1}). Mean temperature, relative humidity, and precipitation values were 22°C (range=19 to 27°C), 70% (range=49 to 93%), and 4.0 mm (range=0 to 20 mm) during pollination, respectively.

Seventy six recipient wheat fields grown in 2002 at various distances (0 to 8.5 km) and directions (NE, SE, SW, and NW) from the Purendo-38 pollinator field are described in Table 2.

Fields were divided into four groups (NE, SE, SW, and NW quadrants) relative to the central 33 ha pollinator field. Distances (km) of the 76 fields are relative to the closest edge of the pollinator field. The NE quadrant contained 29 fields located 0.2 to 8.1 km from the pollinator. The NW quadrant contained eight fields located 4.9 to 8.5 km from the pollinator. The SE quadrant contained 16 fields located 0.2 to 7.0 km from the pollinator. The SW quadrant contained 23 fields located 1.7 to 8.1 km from the pollinator.

Of the 76 fields, 60 fields were seeded with a Canada Western Red Spring (CWRS) cultivar, eight fields with a Canada Prairie Spring red-seeded (CPS-R) cultivar, one field with a Canada Prairie Spring white-seeded (CPS-W) cultivar, and seven fields with a Canada Western Amber Durum (CWAD) cultivar. The CWRS class was represented by eight cultivars including AC Barrie (n=19 fields), McKenzie (n=9), AC Cadillac (n=8), CDC Teal (n=8), AC Elsa (n=6), AC Superb (n=4), and HR5500 (n=4). The CPS class was represented by two red-seeded cultivars (AC Taber, n=6; AC Crystal, n=2) and one white-seeded cultivar (AC Vista, n=1). The CWAD class was represented by seven fields of AC Avonlea. The average number of seeds collected per sample averaged 9570 seeds (SD=2961; SE=340; and range=3178 to 16308 seeds). The total number of seeds collected per field averaged 38279 seeds (SD=11843; SE=1358; and range=12713 to 65232). Approximately three million seeds were screened.

Gene flow rates of 0 to 0.01% were calculated once putative light blue hybrid seeds were confirmed to be segregating for the blue-aleurone trait (Table 2). Long distance gene flow was not detected beyond 190 m from the edge of the pollinator field. A trace level of long distance gene flow was confirmed in one of four samples harvested from field #1. That is, a trace gene flow rate of 0.01% ([1/12360] x 100) was detected in AC Cadillac at 190 m to the N of the pollinator. The detection of this out-crossed seed was from a field located across the highway from the Purendo-38 source field.

2003 Experiment

In 2003, the estimated duration of flowering was 9 d for Purendo-38 (5% anthesis on 10 July to 95% on 18 July). The estimated over-lap in pollination periods between the Purendo-38 pollinator field and recipient fields varied from five to 9 d (Table 3). Prevailing winds were from the W or SW for 4 d (averaging 8 km h^{-1}), NW or WNW for 3 d (averaging 14 km h^{-1}), ENE for 1 d (averaging 9 km h^{-1}), and SSE for 1 d (averaging 22 km h^{-1}) of pollination (Table 1). Mean wind speed during pollination was 14 km h^{-1} (range=9 to 22 km h^{-1}). Mean daily temperature, relative humidity, and precipitation values were 19°C (range=16 to 22°C), 76% (range=65 to 88%), and 1 mm (range=0 to 7 mm) during pollination, respectively.

In 2003, 76 recipient wheat fields grown at various distances (0 to 11.8 km) and directions (NE, SE, SW, and NW) from the Purendo-38 pollinator field are described in Table 3. Distances are relative to the centre of the Purendo-38 pollinator block. Distances of the 76 fields used in 2003 were adjusted to be relative to the closest edge of the pollinator. The NE quadrant contained 20 fields located 0.5 to 9.5 km from the pollinator. The NW quadrant contained 28 fields located 2.7 to 11.8 km from the pollinator. The SE quadrant contained 11 fields located 0.6 to 5.0 km from the pollinator. The SW quadrant contained 17 fields located 3.8 to 10.7 km from the pollinator.

Of the 76 fields, 69 fields were seeded with a CWRS cultivar, five fields with the CPS-R cultivar AC Taber, and two fields with hard white wheat (HW) cultivar AC Snowbird. The CWRS class was represented by nine cultivars including AC Barrie (n=15), McKenzie (n=9), AC Cadillac (n=3), CDC Teal (n=8), AC Elsa (n=19), AC Superb (n=3), HR5500 (n=4), HR5600 (n=5), and AC Splendor (n=3). The average number of seeds collected per sample averaged 32087 seeds (SD=6879; SE=789; and range=18130 to 49936 seeds). The total number of seeds collected per field averaged 128347 seeds (SD=27518; SE=3157; and range=72519 to 199744). Approximately 10 million seeds were screened.

Gene flow rates of 0 to 0.01% were calculated once putative light blue hybrids seeds were confirmed to be segregating for the blue-aleurone trait (Table 3). Long distance gene flow was detected at 0.5 to 2.75 km from the edge of the pollinator block in fields #1, 22, and 49. One of four samples harvested from field #1 contained four confirmed hybrid seeds. One of four samples harvested from field #22 contained one confirmed hybrid seed. Two of four samples harvested from field #49 contained three and one confirmed hybrid seeds. That is, a trace gene flow rate of ≤0.01% was detected in AC Splendor at 500 m to the NE of the pollinator ([4/33310] x 100 = 0.01%), AC Taber at 630 m to the SE (ranged from [1/28396] x 100 = 0.004% in the first sample collected from this field to [3/28396] x 100 = 0.01% in the second sample), and HR5500 at 2.75 km to the NW ([1/19218] x 100 = 0.01%). Long distance pollen-mediated gene flow was not detected beyond 2.75 km of the pollinator source in either year of study.

Of the nine putative hybrids detected in 2003, all conformed to expectations for a cross with Purendo-38 based on morphological data (Table 4). All F1 hybrid plants were tip-awned and as expected only the AC Taber/Purendo-38 F_1 hybrid segregated for awns in the F2 population. All F2 populations segregated for seed type as expected based on the recipient field. Of the 96 F2 seeds advanced from each confirmed hybrid plant, as expected, only the 48 blue-aleurone seeds segregated or bred true for blue grain color while the 48 non-blue seeds bred true for non-blue grain color.

Of the nine putative hybrids, all conformed with expectations for a cross with Purendo-38 based on omega, gamma, beta, and alpha-gliadin protein fingerprints. Samples collected from recipient fields #1, 22, and 49 were verified to be AC Splendor, HR5500, and AC Taber, respectively, when compared to breeder seed reference samples. For field #1, all 20 to 25 F_2-derived F_3 seeds analyzed from each of the four putative hybrid seeds showed segregation for gliadin patterns when compared with the patterns of AC Splendor and Purendo-38 (Fig. 1.). For field #22, all 30 F_2-derived F_3 seeds analyzed (from the one putative hybrid seed identified) showed segregation for gliadin patterns when compared with the patterns of HR5500 and Purendo-38 (data not shown). For field #49, all 15 to 25 F_2-derived F_3 seeds analyzed from each of the four hybrid seeds identified showed segregation for gliadin patterns when compared with the patterns of AC Taber and Purendo-38.

Survey of 2002 target fields for blue-aleurone carrying wheat volunteer in the 2003 to 2005 crops

In 2003, the 76 target fields studied in 2002 were surveyed for blue aleurone grain. The sampling was conducted regardless of the crop in the rotation post pollen-outflow. Of the 76 fields, 57 fields were determined to have been seeded to a non-cereal crop. Volunteers were not observed within these fields and were consequently not sampled. Of the 19 fields sown to a cereal (14 barley, 1 oat, 4 wheat) in 2003, 10 barley fields contained wheat volunteer plants. Those 10 barley fields along with the four wheat fields were sampled at their four corners at maturity.

All spikes collected from the 10 barley and four wheat fields were characterized as possessing only non-blue seed, indicating that no blue-aleurone carrying volunteers were observed in the 19 fields sown to cereals in 2003 (Table 5)

In 2004, the 76 target fields studied in 2002 were again surveyed for blue aleurone grain. Of the 76 fields, 19 fields were determined to have been seeded to a non-cereal crop. Volunteers were not observed within these fields and were consequently not sampled. One field (2002-31) was split between canola and barley. Wheat volunteers were absent from both field sections and this field was grouped in the non-cereal category. Of the 57 fields sown to a cereal (17 barley, 4 triticale, 3 oat, 3 canaryseed, 1 fall rye and 29 wheat) in 2004, five barley fields contained wheat volunteer plants. Those five barley fields along with the 29 wheat fields were sampled at their four corners at maturity. Wheat spikes from each sample were individually threshed and visually inspected. The average number of seeds collected per wheat field averaged 18141 seeds (SD=3609; SE= 670; and range=8170 to 22179). All spikes collected were characterized as possessing only non-blue seed, indicating that no blue aleurone-carrying volunteers were observed.

In 2005, the 76 target fields studied in 2002 were again surveyed for blue aleurone grain. Of the 76 fields, 55 fields were determined to have been seeded to a non-cereal crop and no wheat volunteers were detected at heading time. Two fields (2002-8 and 2002-12) were split between canola and pea crops and another field (2002-20) was split between oat and pea while 2002-23 was split between oat and canola. Wheat volunteers were absent from both of the latter fields' sections and were grouped in the non-cereal category. The cereal fields consisted of 9 barley, 3 oat and 9 wheat (one wheat field was harvested by the cooperator prior to sampling). Five barley fields contained wheat volunteers at maturity. No blue-aleurone volunteer wheat plants were observed in the sampled areas for the eight wheat and five barley fields (Table 5). An estimated 460,000 wheat seeds were examined from the eight wheat fields.

Thus, no blue aleurone wheat was detected in the three years post-harvest for the 2002 experiment. Furthermore, no blue aleurone volunteers were detected in the 2002 blue aleurone pollen donor field proper.

Survey of 2003 target fields for blue-aleurone carrying wheat volunteer in the 2004 to 2006 crops

In 2004, the 76 target fields studied in 2003 were sampled for blue aleurone grain. Of the 76 fields, 55 fields were determined to have been seeded to a non-cereal crop or summer-fallowed (n=5). Of the cereal fields, eight were barley, three oat, two canaryseed and four wheat (one field split with flax). The eight barley fields along with three lentil and two flax fields contained wheat volunteers. No volunteer blue aleurone wheat plants were observed in the sampled areas for the 13 non-wheat fields. An average of 12394 total seeds (SD=6980; SE=3490; and range=2005 to 17079) were screened per wheat field, totaling approximately 198,300 seeds. All spikes collected were characterized as possessing only non-blue seed (Table 6)

In 2005, the 76 target fields studied in 2003 were again sampled for blue aleurone grain. Of the 76 fields, 25 fields were determined to have been seeded to a non-cereal crop and one was summer-fallowed. The cereal fields surveyed in 2005 consisted of 31 barley and 19 wheat fields. Fifteen of the barley fields and a borage field contained volunteer plants. None of those plants carried blue aleurone seed. No blue aleurone volunteer wheat plants were observed in the sampled areas for the 19 wheat fields (Table 6). An estimated 1,200,000 wheat seeds were examined from the 19 wheat fields sampled in 2005.

Of the 76 fields surveyed in 2006, 30 fields were determined to have been seeded to a non-cereal crop, 18 were summer-fallowed and two were flooded due to excessive rainfall. The cereal fields surveyed in 2006 consisted of six barley, one oat and 18 wheat fields. Three of the barley fields contained volunteer plants. None of those plants carried blue aleurone seed. No blue aleurone volunteer wheat plants were observed in the sampled areas for the 18 wheat fields (Table 6). An estimated 1,800,000 wheat seeds were examined from the 18 wheat fields sampled in 2006.

Thus, no blue aleurone wheat was detected in the three years post-harvest in the recipient fields for the 2003 experiment.

No blue aleurone volunteers were detected in the 2003 blue aleurone pollen donor field when seeded to peas (2004) or canola (2005). In 2006, the 2003 pollen donor field was sown to wheat. The quadrat sample taken from the centre of the field contained two spikes segregating for grain color (blue aleurone vs non-blue). One spike produced 44 seeds and the other 26 seeds. These two spikes could represent different plants or, based on their relative seed production, these two spikes could be from the same plant (main stem and T1 tiller). One would expect wheat volunteers in that field to produce all blue aleurone seed. This suggests that the spikes sampled in 2006 were the result of hybridization either in the Purendo38 field as result of pollen drift from adjoining wheat fields in 2003 or that the wheat seed sown in 2006 contained blue aleurone segregants resulting from gene flow into an adjoining field grown in 2003 and subsequently used as a seed source. As part of this study two wheat fields were sampled within 600 meters of the 2003 Purendo field (Table 3) and both contained evidence of gene flow. One of the fields was sown to CWRS wheat and the other to CPS wheat.

The seed from the two segregating spikes harvested in 2006 will be grown out to examine the resulting plants for plant type and seed type as this may suggest which wheat class was involved in the putative gene flow in the volunteer plant.

The near-absence of blue aleurone wheat volunteers (and wheat volunteers in general) during the three years post-harvest is consistent with results from a recent study by Harker et al. (2005). In the Harker et al. study wheat volunteer counts were close to zero, two and three years after the dispersal of the wheat seed. Furthermore, volunteer wheat was detected in half (4 of 8) of the sites after two or three years post wheat crop.

Conclusions and Recommendations

Good pollination overlap between AC Cadillac and Purendo-38 along with strong and prevailing winds from the south were factors that likely contributed to the out crossing event detected in 2002 (Table 1 and 2). Good pollination overlap between the recipient fields and Purendo-38 along with prevailing winds appear to be associated with all nine out crossing events in 2003 (Table 1 and 3), indicating that gene flow rates should not be based on experiments oriented in only one direction from the pollinator. In particular, strong and prevailing winds from the SSE (22 km h^{-1} ±8) were associated with the out crossing event detected in recipient field HR5500 at 2.75 km to the NW of the pollen source.

Pollination periods in 2002 were generally hotter and less humid relative to pollination periods in 2003, indicating that the higher gene flow rates observed in 2003 were likely promoted by cooler and more humid conditions. De Vries (1972) reported that the highest concentration of pollen dispersal appeared to be released at a temperature of 16-20°C and relative humidity of 70-75%. Wheat pollen grains have been reported to be viable for 15 to 20–min, or up to 30 min under optimal conditions (de Vries, 1971). In the present study, the weather conditions in 2003 fall within the optimum range reported by de Vries (1972).

Pollen dispersal during flowering varies with pollinator field size (de Vries, 1974). Gene flow studies in wheat have generally used small pollinator plots (≤0.25 ha) and, thus, likely have limited application in estimating the amount of gene flow taking place between neighboring commercial fields. Matus-Cádiz et al. (2004) reported trace intraspecific pollen-mediated gene flow (0.01%) at 300 m using a 50 x 50 m (0.25 ha) blue-grained pollinator block. The latter study used the largest pollinator field tested to date; however, its small size relative to using commercial scale pollinator fields (20 to 100 ha) may explain, in part, why gene flow was not detected beyond 300 m even though sampling occurred up to 2.76 km from the 0.25 ha pollinator source.

The current project is likely the first large scale commercial study on gene flow in wheat. We detected long distance pollen-mediated gene flow at trace levels (≤0.01%) beyond 300 m which remained constant up to 2.75 km from the pollinator. Trace rates of 0.01% can be considered worst-case scenarios if compared with gene flow rates that are averaged across samples within years. In 2002 one-hybrid seed was confirmed out of three million seeds (gene flow = [1/3000000] x 100 =0.00003%; 300 times lower than 0.01%) while nine hybrid seeds were confirmed out of 10 million seeds in 2003 (gene flow = [9/10000000] x 100 =0.00009%; 100 times lower than 0.01%).

The three year post-harvest surveys failed to detect volunteer blue aleurone volunteer wheat in the 76 recipient fields initially sampled in either the 2002 or 2003 experiments. A single putative out-crossed blue aleurone volunteer was detected in the 2003 donor field. Thus, the probability of a gene-flow event ending up as a volunteer in another crop, wheat or otherwise, was very low. For the wheat fields sampled over the three years post-harvest, an estimated 4.2 million seeds were examined in total. Of those 4.2 million seeds 28 were blue aleurone and were traced to a single putative volunteer plant.

In conclusion, our results suggest that gene flow will be a minor contributor to product admixture (≤0.01%), but a tolerance level of 0% transgenic wheat in non-transgenic wheat grain, as currently demanded by some groups of producers and consumers, is unrealistic. Tolerance levels, likely ranging from one to 5%, will have to be established based on the impurities arising from various trans-gene contributors such as breeder and certified seed purity, gene flow from neighboring fields, occurrence of gene introgression from related or weedy interspecific hybrids, crop volunteers, on-farm admixture, and mechanical admixture during grain handling at or beyond the primary elevator.

Future studies on gene flow in Saskatchewan-grown wheat might focus on wheat growing regions were wheat is the dominant crop in the crop rotation. In the current project we sampled a region where wheat represented 5 to 38 % of the fields surveyed in the post-harvest portion of study. In regions with a higher frequency of wheat in the crop rotation, gene flow and subsequent introgressed volunteer levels may very well be higher.

ACKNOWLEDGMENTS

Thanks are extended to Dr. Brigitte Dupuis and G. Bell (CGC-GRL, Winnipeg, MB) for the A-PAGE gliadin fingerprinting. The Canadian Food Inspection Agency provided financial support for the seed multiplication of the pollen donor. The assistance of the producers whose fields were sampled over the courser of this study is very much appreciated. Without their cooperation this study would not have been possible.

Literature cited

Abdel-Aal, E.-S.M., and P. Hucl. 1999. A rapid method for quantifying total anthocyanins in blue aleurone and purple pericarp wheats. Cereal Chem. 76:350-354.

de Vries, A. P. 1971. Flowering biology of wheat particularly in view of hybrid seed production: a review. Euphytica 20:152-170.

de Vries, A.P. 1972. Some aspects of cross pollination in wheat (*Triticum aestivum* L). 1. Pollen concentration in the field as influenced by cultivar, diurnal pattern, weather conditions, and level as compared to the height of the pollen donor. Euphytica 21: 185-203.

de Vries, A.P. 1974. Some aspects of cross pollination in wheat (*Triticum aestivum* L). 4. Seed set on male sterile plants as influenced by distance from pollen source, pollinator: male sterile ratio, and width of the male sterile strip. Euphytica 23: 601-622.

Hanson, B.D., C.A. Mallory-Smith, B. Shafii, D.C. Thill, and R.S. Zemetra. 2005. Pollen-mediated gene flow from blue aleuroned wheat to other cultivars. Crop Sci. 45:1610-1617.

Harker, K.N., G.W. Clayton, R.E. Blackshaw, J.T. O'Donovan, E.N. Johnson, Y. Gan, F.A. Holm, K.L. Sapsford, R.B. Irvine and R.C. Van Acker. 2005. Glyphosate-resistant wheat persistence in western Canadian cropping systems. Weed Sci. 53:846-859.

Hucl, P. 1996. Out-crossing rates for 10 Canadian spring wheat cultivars. Can. J. Plant Sci. 76:423-427.

Hucl, P., and M.A. Matus-Cádiz. 2001. Isolation distances for minimizing out-crossing in spring wheat. Crop Sci. 41:1348-1351.

International Standardization Organization. 1993. Wheat – Identification of varieties by electrophoresis. p. 1-10 *In* International Standard ISO 8981. International Organization for Standardization. Geneva, Switzerland.

Johnson, V.A., and J.W. Schmidt. 1968. Hybrid wheat. Advances in Agronomy. 20:199-232.

Martin, T.J. 1990. Out-crossing in twelve hard winter wheat cultivars. Crop Sci. 30:59-62.

Matus-Cádiz, M.A., P. Hucl, M.J. Horak, and L.K. Blomquist. 2004. Gene flow in wheat at the field level. Crop Sci. 44:718-727.

Rieger M.A., M. Lamond, C. Preston, S.B. Powles, and R.T.Roush. 2002. Pollen-mediated movement of herbicide resistance between commercial canola fields. Science 296:2386-2388.

Waines, J.G., and S. G. Hegde. 2003. Intraspecific gene flow in bread wheat as affected by reproductive biology and pollination ecology of wheat flowers. Crop Sci. 2003 43:451-463.

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(May 1 –June 30, 2003) – 100%

V. Spilchuk, Tech. Assistant (August 1 to 31, 2004) – 100%

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Equipment: None purchased for this project.
Project Developed Materials: Nil.
Project photos: see attached photo APAGE gel
Expense statement: under separate cover from University of Saskatchewan Financial Services.

Table 1. Meteorological data (± SD) for the estimated pollination period of Purendo-38, the blue-grained pollinator, in 2002 and 2003.

Day	Prevailing Wind	Average wind speed ($km\ h^{-1}$)	Average temperature (°C)	Relative humidity (%) Maximum	Relative humidity (%) Minimum	Total precipitation (mm)
2002						
14 July	S	26 ±8	27 ±5	83	36	0
15 July	NW	13 ±4	24 ±4	94	26	0
16 July	NW & N	12 ±4	22 ±4	72	26	0
17 July	ENE	17 ±9	19 ±5	100	54	20
18 July	S	16 ±7	24 ±5	100	59	0
19 July	ENE	12 ±3	19 ±1	100	86	5
20 July	W	15 ±6	20 ±3	100	43	1
2003						
10 July	NW & WNW	19 ±6	16 ±2	100	75	1
11 July	W & WSW	14 ±4	18 ±5	100	49	0
12 July	SSW	17 ±5	22 ±6	97	43	0
13 July	NW	14 ±6	20 ±2	100	69	7
14 July	W & SSW	10 ±4	16 ±2	100	71	1
15 July	SW & W	15 ±3	20 ±6	100	45	0
16 July	ENE	9 ±3	16 ±3	97	48	0
17 July	SSE	22 ±8	21 ±5	97	49	0
18 July	WNW & S	10 ±4	20 ±6	100	29	0

Table 2. Gene flow (%) in 76 recipient wheat fields grown in 2002 at various distances (0 to 8.5 km; ± SD) and directions (NE, SE, SW, and NW) from the Purendo-38 pollinator field. Fields were divided into four groups (NE, SE, SW, and NW quadrants) relative to the central 33 ha pollinator field.

Field	Quadrant	Distance from edge of pollinator (km)	±SD	Crop type	Class	Seeding date	Occurrence of flowering in recipient fields during pollination period of Purendo-38: 5% (15 July)	50% (17 July)	95% (19 July)	Average No. of seeds collected per sample	±SD	Total No. of seeds collected per field	Gene flow (%)
1	NE	0.19	0.13	AC Cadillac	CWRS	7 May	Flowering	Flowering	Flowering	12360	913	49438	0.01
2	NE	1.53	0.14	AC Barrie	CWRS	3 May	Flowering	Complete	Complete	9401	1755	37603	0
3	NE	1.60	0.13	AC Cadillac	CWRS	7 May	Flowering	Flowering	Flowering	14888	1308	59551	0
4	NE	2.00	0.13	AC Avonlea	CWAD	14 May	Flowering	Flowering	Complete	6258	259	25033	0
5	NE	2.15	0.17	AC Cadillac	CWRS	17 May	Flowering	Flowering	Flowering	14392	1549	57568	0
6	NE	2.50	0.13	AC Avonlea	CWAD	14 May	Flowering	Flowering	Complete	6403	552	25613	0
7	NE	2.60	0.13	AC Elsa	CWRS	15 May	Flowering	Flowering	Complete	11459	1050	45834	0
8	NE	3.09	0.20	AC Cadillac	CWRS	6 May	Flowering	Flowering	Flowering	12220	3223	48881	0
9	NE	3.49	0.17	AC Elsa	CWRS	15 May	-	-	Flowering	12248	1391	48991	0
10	NE	4.33	0.16	AC Elsa	CWRS	15 May	-	-	Flowering	11956	1139	47823	0
11	NE	4.36	0.17	AC Superb	CWRS	11 May	Flowering	Complete	Complete	8876	828	35505	0
12	NE	4.46	0.13	CDC Teal	CWRS	8 May	Flowering	Complete	Complete	11603	2406	46413	0
13	NE	5.03	0.05	CDC Teal	CWRS	12 May	Flowering	Flowering	Complete	7127	848	28509	0
14	NE	5.57	0.19	AC Cadillac	CWRS	7 May	Flowering	Flowering	Complete	13631	1440	54522	0
15	NE	5.59	0.09	AC Superb	CWRS	1 May	Flowering	Flowering	Complete	8649	394	34596	0
16	NE	5.67	0.17	AC Barrie	CWRS	8 May	Flowering	Flowering	Complete	10328	1298	41313	0
17	NE	5.85	0.17	AC Superb	CWRS	22 May	Flowering	Flowering	Complete	7122	1321	28486	0
18	NE	6.21	0.21	AC Cadillac	CWRS	7 May	Flowering	Flowering	Complete	14526	1102	58105	0
19	NE	6.27	0.15	AC Barrie	CWRS	5 May	Flowering	Flowering	Complete	12071	2497	48283	0
20	NE	6.31	0.13	CDC Teal	CWRS	7 May	Flowering	Flowering	Complete	13190	1866	52758	0
21	NE	6.32	0.18	AC Avonlea	CWAD	7 May	Flowering	Flowering	Complete	6362	1774	25449	0
22	NE	6.68	0.12	Mckenzie	CWRS	11 May	Flowering	Flowering	Complete	10832	880	43327	0
23	NE	7.06	0.02	AC Barrie	CWRS	1 May	Flowering	Complete	Complete	9958	1794	39831	0
24	NE	7.17	0.07	Mckenzie	CWRS	10 May	Flowering	Complete	Complete	10580	1401	42320	0
25	NE	7.19	0.06	Mckenzie	CWRS	11 May	Flowering	Flowering	Complete	8188	2967	32751	0
26	NE	7.30	0.06	Mckenzie	CWRS	10 May	Flowering	Complete	Complete	11931	2458	47722	0
27	NE	7.59	0.09	AC Barrie	CWRS	5 May	Flowering	Complete	Complete	10138	1712	40552	0
28	NE	8.04	0.08	AC Barrie	CWRS	5 May	Flowering	Flowering	Flowering	8300	1760	33198	0
29	NE	8.09	0.21	AC Barrie	CWRS	3 May	Flowering	Complete	Complete	9765	1448	39061	0
30	NW	4.86	0.14	AC Elsa	CWRS	6 May	Flowering	Complete	Complete	10550	3501	42201	0
31	NW	5.52	0.18	AC Barrie	CWRS	5 May	Flowering	Flowering	Complete	15314	2479	61257	0
32	NW	5.69	0.05	5500HR	CWRS	7 May	Flowering	Complete	Complete	8361	1671	33445	0
33	NW	6.44	0.13	Mckenzie	CWRS	8 May	Flowering	Complete	Complete	11674	935	46697	0
34	NW	7.54	0.30	Katepwa	CWRS	12 May	Flowering	Flowering	Complete	15388	800	61551	0
35	NW	8.06	0.15	CDC Teal	CWRS	9 May	Flowering	Flowering	Complete	9334	1804	37337	0

36	NW	8.23	0.12	AC Superb	CWRS	2 May	Flowering	Flowering	Complete	4316	1120	17265	0
37	NW	8.48	0.13	CDC Teal	CWRS	9 May	Flowering	Flowering	Complete	10941	1368	43763	0
38	SE	0.15	0.13	AC Crystal	CPS-R	14 May	Flowering	Flowering	Complete	4690	1983	18761	0
39	SE	0.51	0.22	AC Barrie	CWRS	8 May	Flowering	Flowering	Complete	8714	1016	34854	0
40	SE	0.93	0.12	AC Elsa	CWRS	15 May	Flowering	Complete	Flowering	13916	2680	55664	0
41	SE	1.10	0.13	AC Taber	CPS-R	20 May	Flowering	Flowering	Complete	8139	958	32556	0
42	SE	2.25	0.20	AC Barrie	CWRS	3 May	Flowering	Flowering	Complete	12603	969	50412	0
43	SE	3.26	0.17	AC Cadillac	CWRS	24 May	Flowering	Complete	Complete	5655	1146	22620	0
44	SE	3.38	0.15	CDC Teal	CWRS	24 May	Flowering	Flowering	Complete	9284	972	37135	0
45	SE	4.69	0.20	AC Barrie	CWRS	20 May	Flowering	Complete	Complete	8164	1564	32657	0
46	SE	5.17	0.26	CDC Teal	CWRS	9 May	Flowering	Flowering	Flowering	8960	1861	35840	0
47	SE	5.30	0.15	AC Taber	CPS-R	17 May	Flowering	Flowering	Flowering	12924	1767	51695	0
48	SE	5.65	0.20	AC Crystal	CPS-R	14 May	Flowering	Flowering	Complete	11517	1455	46066	0
49	SE	5.73	0.07	AC Avonlea	CWAD	15 May	Flowering	Flowering	Complete	8361	1201	33444	0
50	SE	6.00	0.10	AC Avonlea	CWAD	16 May	Flowering	Flowering	Complete	8967	125	35866	0
51	SE	6.14	0.17	CDC Teal	CWRS	10 May	Flowering	Complete	Complete	12149	2082	48597	0
52	SE	6.96	0.12	AC Barrie	CWRS	1 May	Flowering	Flowering	Complete	3653	808	14611	0
53	SE	6.97	0.14	AC Barrie	CWRS	1 May	Flowering	Flowering	Complete	6420	1212	25680	0
54	SW	1.74	0.15	5500HR	CWRS	4 May	Flowering	Flowering	Flowering	9660	1246	38640	0
55	SW	1.87	0.20	Mckenzie	CWRS	17 May	Flowering	Flowering	Complete	9629	996	38517	0
56	SW	2.50	0.17	Mckenzie	CWRS	18 May	Flowering	Flowering	Complete	9484	2298	37937	0
57	SW	2.73	0.33	Mckenzie	CWRS	16 May	Flowering	Flowering	Complete	10452	1068	41808	0
58	SW	3.13	0.11	5500HR	CWRS	4 May	Flowering	Flowering	Complete	6007	687	24029	0
59	SW	4.17	0.13	AC Barrie	CWRS	5 May	Flowering	Flowering	Complete	4174	1325	16696	0
60	SW	4.28	0.25	AC Avonlea	CWAD	10 May	Flowering	Flowering	Complete	6660	893	26641	0
61	SW	4.28	0.15	AC Avonlea	CWAD	10 May	Flowering	Flowering	Complete	7208	729	28832	0
62	SW	4.96	0.10	AC Cadillac	CWRS	6 May	Flowering	Flowering	Complete	9459	1599	37835	0
63	SW	5.10	0.20	Katepwa	CWRS	15 May	Flowering	Flowering	Complete	11165	1050	44659	0
64	SW	5.19	0.17	AC Taber	CPS-R	12 May	Flowering	Flowering	Complete	6111	585	24444	0
65	SW	5.76	0.12	AC Vista	CPS-W	1 May	Flowering	Flowering	Complete	4391	677	17563	0
66	SW	5.84	0.18	AC Taber	CPS-R	11 May	Flowering	Flowering	Complete	5400	2283	21601	0
67	SW	5.97	0.17	AC Taber	CPS-R	12 May	Flowering	Flowering	Complete	8188	1280	32753	0
68	SW	6.08	0.18	AC Barrie	CWRS	20 May	Flowering	Flowering	Flowering	9371	1481	37485	0
69	SW	6.22	0.23	AC Taber	CPS-R	11 May	Flowering	Flowering	Complete	7488	2358	29951	0
70	SW	6.30	0.13	AC Elsa	CWRS	14 May	Flowering	Flowering	Complete	10174	1003	40695	0
71	SW	6.44	0.15	5500HR	CWRS	1 May	Flowering	Flowering	Complete	16308	1911	65232	0
72	SW	6.51	0.08	Mckenzie	CWRS	13 May	Flowering	Flowering	Flowering	9904	1348	39616	0
73	SW	6.67	0.14	AC Barrie	CWRS	22 May	Flowering	Flowering	Flowering	3178	1014	12713	0
74	SW	7.53	0.12	AC Barrie	CWRS	8 May	Flowering	Flowering	Complete	9192	2408	36766	0
75	SW	8.04	0.12	AC Barrie	CWRS	8 May	-	-	Flowering	9316	2236	37262	0
76	SW	8.13	0.16	AC Barrie	CWRS	9 May	Flowering	Flowering	Complete	9622	1060	38486	0

Table 3. Gene flow (%) in 76 recipient wheat fields grown in 2003 at various distances (0 to 11.8 km; ± SD) and directions (NE, SE, SW, and NW) from the Purendo-38 pollinator field. Fields were divided into four groups (NE, SE, SW, and NW quadrants) relative to the central 20 ha pollinator field.

Field	Quadrant	Distance from edge of pollinator (km)	±SD	Crop type	Class	Seeding date	Occurrence of flowering in recipient fields during pollination period of Purendo-38			Average No. of seeds collected per sample	±SD	Total No. of seeds collected per field	Gene flow (%)
							5% (10 July)	50% (14 July)	95% (18 July)				
1	NE	0.50	0.10	AC Splendor	CWRS	10 May	Flowering	Flowering	Flowering	33310	2421	133241	0.01
2	NE	2.49	0.09	AC Elsa	CWRS	18 May	-	Flowering	Flowering	43773	2998	175090	0
3	NE	2.77	0.25	AC Elsa	CWRS	18 May	-	Flowering	Flowering	42394	5229	169575	0
4	NE	3.16	0.17	AC Elsa	CWRS	18 May	-	Flowering	Flowering	42972	4022	171886	0
5	NE	4.33	0.29	AC Barrie	CWRS	1 May	Flowering	Flowering	Complete	25579	2897	102314	0
6	NE	4.43	0.14	AC Elsa	CWRS	14 May	-	Flowering	Flowering	42994	5555	171975	0
7	NE	4.59	0.15	CDC Teal	CWRS	7 May	Flowering	Flowering	Complete	21945	7292	87780	0
8	NE	4.90	0.10	AC Elsa	CWRS	14 May	-	Flowering	Flowering	49936	2525	199744	0
9	NE	5.69	0.19	AC Elsa	CWRS	12 May	Flowering	Flowering	Complete	32577	2271	130308	0
10	NE	5.82	0.26	AC Barrie	CWRS	14 May	-	Flowering	Flowering	26524	2401	106095	0
11	NE	6.12	0.12	AC Elsa	CWRS	12 May	Flowering	Flowering	Complete	31909	4616	127635	0
12	NE	6.70	0.47	AC Snowbird	HW	19 May	Flowering	Flowering	Flowering	39065	3391	156261	0
13	NE	6.80	0.55	AC Barrie	CWRS	15 May	-	Flowering	Flowering	36294	2826	145177	0
14	NE	7.22	0.01	AC Barrie	CWRS	15 May	-	Flowering	Flowering	27801	4348	111202	0
15	NE	7.95	0.15	AC Barrie	CWRS	11 May	Flowering	Flowering	Flowering	25004	5585	100016	0
16	NE	8.37	0.22	AC Barrie	CWRS	11 May	Flowering	Flowering	Flowering	23317	5568	93269	0
17	NE	9.04	0.30	AC Superb	CWRS	16 May	-	Flowering	Flowering	34411	4795	137644	0
18	NE	9.19	0.29	AC Barrie	CWRS	13 May	Flowering	Flowering	Complete	38067	4908	152269	0
19	NE	9.25	0.10	AC Barrie	CWRS	13 May	Flowering	Flowering	Complete	40944	3733	163776	0
20	NE	9.51	0.08	AC Barrie	CWRS	13 May	Flowering	Flowering	Complete	43778	1891	175112	0
21	NW	2.72	0.10	AC Barrie	CWRS	26 April	-	Flowering	Flowering	29902	6160	119607	0
22	NW	2.75	0.38	HR5500	CWRS	25 April	Flowering	Flowering	Flowering	19218	3874	76872	0.01
23	NW	2.97	0.34	AC Barrie	CWRS	26 April	-	Flowering	Flowering	29388	4079	117551	0
24	NW	3.35	0.10	HR5500	CWRS	24 April	Flowering	Flowering	Complete	18130	5993	72519	0
25	NW	3.42	0.12	HR5500	CWRS	28 April	Flowering	Flowering	Complete	19164	1346	76655	0
26	NW	3.78	0.19	HR5500	CWRS	26 April	Flowering	Flowering	Complete	19739	845	78956	0
27	NW	4.12	0.10	AC Barrie	CWRS	29 April	Flowering	Flowering	Complete	25645	3241	102581	0
28	NW	4.74	0.23	AC Elsa	CWRS	21 May	-	Flowering	Flowering	41914	7632	167656	0
29	NW	4.74	0.28	AC Superb	CWRS	6 May	Flowering	Flowering	Flowering	22411	3231	89642	0
30	NW	4.98	0.28	CDC Teal	CWRS	5 May	Flowering	Flowering	Flowering	30977	2592	123907	0
31	NW	5.02	0.10	AC Elsa	CWRS	21 May	-	Flowering	Flowering	40080	4754	160319	0
32	NW	5.19	0.33	McKenzie	CWRS	20 May	-	Flowering	Flowering	21371	5287	85485	0
33	NW	5.73	0.19	AC Barrie	CWRS	8 May	Flowering	Flowering	Complete	28433	3145	113731	0
34	NW	6.33	0.25	AC Elsa	CWRS	20 May	-	Flowering	Flowering	19083	4772	76331	0

35	NW	6.53	0.34	AC Cadillac	CWRS	9 May	-	Flowering	Flowering	37920	1205	151681	0
36	NW	7.49	0.01	AC Elsa	CWRS	15 May	-	Flowering	Flowering	35566	3381	142262	0
37	NW	7.73	0.17	AC Elsa	CWRS	15 May	-	Flowering	Flowering	37677	10937	150708	0
38	NW	7.86	0.01	AC Elsa	CWRS	15 May	-	Flowering	Flowering	31042	4642	124167	0
39	NW	8.46	0.29	AC Cadillac	CWRS	9 May	Flowering	Flowering	Flowering	36170	2786	144679	0
40	NW	9.40	0.29	AC Cadillac	CWRS	9 May	Flowering	Flowering	Flowering	35397	4004	141587	0
41	NW	9.73	0.30	McKenzie	CWRS	18 May	-	Flowering	Flowering	35665	3066	142661	0
42	NW	9.79	0.17	McKenzie	CWRS	18 May	-	Flowering	Flowering	37936	6322	151744	0
43	NW	10.06	0.37	McKenzie	CWRS	19 May	-	Flowering	Flowering	28841	6249	115364	0
44	NW	10.88	0.17	AC Snowbird	HW	15 May	Flowering	Flowering	Complete	33744	5601	134974	0
45	NW	11.28	0.10	McKenzie	CWRS	16 May	-	Flowering	Flowering	29280	6556	117119	0
46	NW	11.45	0.06	McKenzie	CWRS	16 May	-	Flowering	Flowering	33721	3168	134884	0
47	NW	11.45	0.13	McKenzie	CWRS	17 May	-	Flowering	Flowering	34299	2218	137196	0
48	NW	11.75	0.13	McKenzie	CWRS	17 May	-	Flowering	Flowering	36281	2504	145125	0
49	SE	0.63	0.10	AC Taber	CPS-R	22 May	-	Flowering	Flowering	28396	3045	113582	0.004 to 0.01
50	SE	1.14	0.25	AC Taber	CPS-R	22 May	-	Flowering	Flowering	26254	5057	105014	0
51	SE	1.33	0.42	AC Barrie	CWRS	29 April	Flowering	Flowering	Complete	25905	2908	103620	0
52	SE	2.53	0.05	AC Taber	CPS-R	24 May	-	Flowering	Flowering	27243	2721	108973	0
53	SE	3.00	0.29	AC Taber	CPS-R	24 May	-	Flowering	Flowering	26312	2918	105247	0
54	SE	3.19	0.04	AC Taber	CPS-R	24 May	-	Flowering	Flowering	26009	4130	104036	0
55	SE	3.76	0.12	AC Splendor	CWRS	1 May	Flowering	Flowering	Flowering	29438	425	117753	0
56	SE	3.99	0.13	AC Splendor	CWRS	1 May	Flowering	Flowering	Flowering	25633	5975	102531	0
57	SE	4.23	0.15	AC Elsa	CWRS	13 May	Flowering	Flowering	Complete	38610	2311	154440	0
58	SE	4.99	0.28	AC Elsa	CWRS	13 May	Flowering	Flowering	Complete	41426	2395	165705	0
59	SE	5.02	0.19	AC Elsa	CWRS	13 May	Flowering	Flowering	Complete	39227	6281	156908	0
60	SW	3.84	0.26	HR 5600	CWRS	5 May	Flowering	Flowering	Complete	32931	6204	131725	0
61	SW	4.80	0.06	AC Elsa	CWRS	14 May	Flowering	Flowering	Complete	34361	2694	137443	0
62	SW	5.03	0.36	HR 5600	CWRS	5 May	Flowering	Flowering	Complete	31568	2736	126270	0
63	SW	5.64	0.49	CDC Teal	CWRS	9 May	-	Flowering	Flowering	31983	5272	127933	0
64	SW	5.70	0.24	HR5600	CWRS	6 May	-	Flowering	Flowering	33130	2518	132521	0
65	SW	6.07	0.08	HR 5600	CWRS	6 May	Flowering	Flowering	Complete	34749	1930	138995	0
66	SW	6.57	0.27	AC Barrie	CWRS	23 May	-	Flowering	Flowering	31837	3259	127348	0
67	SW	6.93	0.13	CDC Teal	CWRS	12 May	Flowering	Flowering	Complete	30392	3975	121567	0
68	SW	7.29	0.18	AC Elsa	CWRS	5 May	Flowering	Flowering	Complete	32450	2754	129801	0
69	SW	7.71	0.32	AC Barrie	CWRS	23 May	-	Flowering	Flowering	29558	3895	118233	0
70	SW	8.45	0.28	CDC Teal	CWRS	10 May	Flowering	Flowering	Flowering	38588	5037	154350	0
71	SW	8.99	0.11	CDC Teal	CWRS	10 May	Flowering	Flowering	Flowering	38774	3791	155095	0
72	SW	9.15	0.34	HR 5600	CWRS	6 May	Flowering	Flowering	Flowering	33756	4597	135022	0
73	SW	9.34	0.21	McKenzie	CWRS	18 May	-	Flowering	Flowering	31342	4468	125366	0
74	SW	9.77	0.18	CDC Teal	CWRS	11 May	Flowering	Flowering	Flowering	30957	2677	123826	0
75	SW	9.86	0.31	AC Superb	CWRS	8 May	Flowering	Flowering	Flowering	22487	2877	89946	0
76	SW	10.73	0.31	CDC Teal	CWRS	11 May	Flowering	Flowering	Complete	33700	4427	134799	0

Table 4. In 2003, F_1-derived F_2 seeds were grown out to observe the segregation of awns and kernel shape from each putative F_1 hybrid plant from fields #1, 22, and 49 to confirm out-crossing with Purendo-38 (tip awned; similar to CWRS type wheat in kernel shape and size).

Field No.	Sample No.	Recipient field (spike type)	No. of putative F_1 hybrid seeds	F_1 hybrid (spike type)		F_2 population	
				Expected	Observed	Spike type	Kernel shape
1	1	AC Splendor (tip awned)	4	tip awned	tip awned	tip awned	CWRS
22	1	HR5500 (tip awned)	1	tip awned	tip awned	tip awned	CWRS
49	1 and 2	AC Taber (awned)	4	tip awned	tip awned	awned and tip awned	CWRS and CPS

Table 5. Survey of 2002 pollen recipient fields for wheat volunteers in 2003, 2004 and 2005

Year initially in wheat	2003 Crop	In-field volunteer wheat count no. spikes	Blue aleurone Seeds no./total	2004 Crop	In-field volunteer wheat count no. spikes	Blue aleurone Seeds no./total	2005 Crop	In-field volunteer wheat count no. spikes	Blue aleurone Seeds no./total
2002-P38-center	peas	0	0	barley	0	0	canola	0	0
2002-P38-NE	peas	0	0	barley	0	0	canola	0	0
2002-P38-SE	peas	0	0	barley	0	0	canola	0	0
2002-P38-SW	peas	0	0	barley	0	0	canola	0	0
2002-P38-NW	peas	0	0	barley	0	0	canola	0	0
2002-1-1	canola	0	0	barley	0	0	peas	0	0
2002-1-2	canola	0	0	barley	0	0	peas	0	0
2002-1-3	canola	0	0	barley	0	0	peas	0	0
2002-1-4	canola	0	0	barley	0	0	peas	0	0
2002-2-1	canola	0	0	wheat		0/13275	canola	0	0
2002-2-2	canola	0	0	wheat		0/24183	canola	0	0
2002-2-3	canola	0	0	wheat		0/22958	canola	0	0
2002-2-4	canola	0	0	wheat		0/23580	canola	0	0
2002-3-1	canola	0	0	wheat		0/25591	canola	0	0
2002-3-2	canola	0	0	wheat		0/19406	canola	0	0
2002-3-3	canola	0	0	wheat		0/24047	canola	0	0
2002-3-4	canola	0	0	wheat		0/15702	canola	0	0
2002-4-1	canola	0	0	wheat		0/14865	canola	0	0
2002-4-2	canola	0	0	wheat		0/20050	canola	0	0
2002-4-3	canola	0	0	wheat		0/17604	canola	0	0
2002-4-4	canola	0	0	wheat		0/20445	canola	0	0
2002-5-1	canola	0	0	canaryseed	0	0	canola	0	0
2002-5-2	canola	0	0	canaryseed	0	0	canola	0	0
2002-5-3	canola	0	0	canaryseed	0	0	canola	0	0
2002-5-4	canola	0	0	canaryseed	0	0	canola	0	0
2002-6-1	peas	0	0	barley	0	0	canola	0	0
2002-6-2	peas	0	0	barley	4	0	canola	0	0
2002-6-3	peas	0	0	barley	5	0	canola	0	0
2002-6-4	peas	0	0	barley	2	0	canola	0	0
2002-7-1	canola	0	0	peas	0	0	barley	0	0
2002-7-2	canola	0	0	peas	0	0	barley	0	0
2002-7-3	canola	0	0	peas	0	0	barley	0	0
2002-7-4	canola	0	0	peas	0	0	barley	0	0
2002-8-1	canola	0	0	canaryseed	0	0	canola/pea	0	0
2002-8-2	canola	0	0	canaryseed	0	0	canola/pea	0	0
2002-8-3	canola	0	0	canaryseed	0	0	canola/pea	0	0
2002-8-4	canola	0	0	canaryseed	0	0	canola/pea	0	0
2002-9-1	canola	0	0	wheat		0/14340	canola	0	0
2002-9-2	canola	0	0	wheat		0/28199	canola	0	0
2002-9-3	canola	0	0	wheat		0/22415	canola	0	0
2002-9-4	canola	0	0	wheat		0/16736	canola	0	0
2002-10-1	barley	4	0	canola	0	0	wheat		0/16066

2002-10-2	barley	2	0	canola	0	0	wheat		0/15591
2002-10-3	barley	2	0	canola	0	0	peas	0	0
2002-10-4	barley	1	0	canola	0	0	peas	0	0
2002-11-1	peas	0	0	barley	0	0	canola	0	0
2002-11-2	peas	0	0	barley	0	0	canola	0	0
2002-11-3	peas	0	0	barley	2	0	canola	0	0
2002-11-4	peas	0	0	barley	0	0	canola	0	0
2002-12-1	canola	0	0	wheat		0/14499	canola/pea	0	0
2002-12-2	canola	0	0	wheat		0/20467	canola/pea	0	0
2002-12-3	canola	0	0	wheat		0/18167	canola/pea	0	0
2002-12-4	canola	0	0	wheat		0/26731	canola/pea	0	0
2002-13-1	canola	0	0	oats	0	0	wheat		0/22125
2002-13-2	canola	0	0	oats	0	0	wheat		0/21400
2002-13-3	canola	0	0	oats	0	0	wheat		0/15684
2002-13-4	canola	0	0	oats	0	0	wheat		0/28660
2002-14-1	barley	50	0	canola	0	0	barley	4	0
2002-14-2	barley	52	0	canola	0	0	barley	5	0
2002-14-3	barley	41	0	canola	0	0	barley	5	0
2002-14-4	barley	21	0	canola	0	0	barley	5	0
2002-15-1	canola	0	0	wheat		0/12486	canola	0	0
2002-15-2	canola	0	0	wheat		0/24971	canola	0	0
2002-15-3	canola	0	0	wheat		0/21665	canola	0	0
2002-15-4	canola	0	0	wheat		0/19254	canola	0	0
2002-16-1	canola	0	0	barley	0	0	canola	0	0
2002-16-2	canola	0	0	barley	0	0	canola	0	0
2002-16-3	canola	0	0	barley	0	0	canola	0	0
2002-16-4	canola	0	0	barley	0	0	canola	0	0
2002-17-1	barley	0	0	barley	0	0	canola	0	0
2002-17-2	barley	0	0	barley	0	0	canola	0	0
2002-17-3	barley	0	0	barley	0	0	canola	0	0
2002-17-4	barley	0	0	barley	0	0	canola	0	0
2002-18-1	wheat		0	canola	0	0	wheat		0/15187
2002-18-2	wheat		0	canola	0	0	wheat		0/17044
2002-18-3	wheat		0	canola	0	0	wheat		0/16497
2002-18-4	wheat		0	canola	0	0	wheat		0/13259
2002-19-1	canola	0	0	wheat		0/11233	barley	16	0
2002-19-2	canola	0	0	wheat		0/23239	barley	14	0
2002-19-3	canola	0	0	wheat		0/15477	barley	18	0
2002-19-4	canola	0	0	wheat		0/27796	barley	10	0
2002-20-1	barley	0	0	canola	0	0	oat/pea	0	0
2002-20-2	barley	0	0	canola	0	0	oat/pea	0	0
2002-20-3	barley	0	0	canola	0	0	oat/pea	0	0
2002-20-4	barley	0	0	canola	0	0	oat/pea	0	0
2002-21-1	canola	0	0	barley	1	0	wheat		0/19388
2002-21-2	canola	0	0	barley	0	0	wheat		0/16811
2002-21-3	canola	0	0	barley	0	0	wheat		0/21169
2002-21-4	canola	0	0	barley	0	0	wheat		0/17084
2002-22-1	canola	0	0	peas	0	0	barley	6	0
2002-22-2	canola	0	0	peas	0	0	barley	5	0
2002-22-3	canola	0	0	peas	0	0	barley	3	0

2002-22-4	canola	0	0	peas	0	0	barley	3	0
2002-23-1	barley	25	0	barley	0	0	canola/oat	0	0
2002-23-2	barley	21	0	barley	0	0	canola/oat	0	0
2002-23-3	barley	14	0	barley	0	0	canola/oat	0	0
2002-23-4	barley	10	0	barley	0	0	canola/oat	0	0
2002-24-1	barley	0	0	canola	0	0	oats	0	0
2002-24-2	barley	0	0	canola	0	0	oats	0	0
2002-24-3	barley	0	0	canola	0	0	oats	0	0
2002-24-4	barley	0	0	canola	0	0	oats	0	0
2002-25-1	canola	0	0	wheat		0/16925	canola	0	0
2002-25-2	canola	0	0	wheat		0/17804	canola	0	0
2002-25-3	canola	0	0	wheat		0/16017	canola	0	0
2002-25-4	canola	0	0	wheat		0/15237	canola	0	0
2002-26-1	lentils	0	0	barley	0	0	canola	0	0
2002-26-2	lentils	0	0	barley	0	0	canola	0	0
2002-26-3	lentils	0	0	barley	0	0	canola	0	0
2002-26-4	lentils	0	0	barley	0	0	canola	0	0
2002-27-1	barley	0	0	canola	0	0	canola	0	0
2002-27-2	barley	0	0	canola	0	0	canola	0	0
2002-27-3	barley	0	0	canola	0	0	canola	0	0
2002-27-4	barley	0	0	canola	0	0	canola	0	0
2002-28-1	canola	0	0	wheat		0/18354	peas	0	0
2002-28-2	canola	0	0	wheat		0/8807	peas	0	0
2002-28-3	canola	0	0	wheat		0/13352	peas	0	0
2002-28-4	canola	0	0	wheat		0/9858	peas	0	0
2002-29-1	canola	0	0	oats	0	0	peas	0	0
2002-29-2	canola	0	0	oats	0	0	peas	0	0
2002-29-3	canola	0	0	oats	0	0	peas	0	0
2002-29-4	canola	0	0	oats	0	0	peas	0	0
2002-30-1	canola	0	0	barley	0	0	peas	0	0
2002-30-2	canola	0	0	barley	0	0	peas	0	0
2002-30-3	canola	0	0	barley	0	0	peas	0	0
2002-30-4	canola	0	0	barley	0	0	peas	0	0
2002-31-1	canola	0	0	canola/barley	0	0	canola	0	0
2002-31-2	canola	0	0	canola/barley	0	0	canola	0	0
2002-31-3	canola	0	0	canola/barley	0	0	canola	0	0
2002-31-4	canola	0	0	canola/barley	0	0	canola	0	0
2002-32-1	canola	0	0	wheat		0/11631	wheat	harvested	
2002-32-2	canola	0	0	wheat		0/26699	wheat	harvested	
2002-32-3	canola	0	0	wheat		0/20796	wheat	harvested	
2002-32-4	canola	0	0	wheat		0/14316	wheat	harvested	
2002-33-1	canola	0	0	barley	0	0	flax	0	0
2002-33-2	canola	0	0	barley	0	0	flax	0	0
2002-33-3	canola	0	0	barley	0	0	flax	0	0
2002-33-4	canola	0	0	barley	0	0	flax	0	0
2002-34-1	canola	0	0	wheat		0/7735	canola	0	0
2002-34-2	canola	0	0	wheat		0/10688	canola	0	0
2002-34-3	canola	0	0	wheat		0/8790	canola	0	0
2002-34-4	canola	0	0	wheat		0/5465	canola	0	0
2002-35-1	canola	0	0	w.wheat		worked under	canola	0	0

2002-35-2	canola	0	0	w.wheat		worked under	canola	0	0
2002-35-3	canola	0	0	w.wheat		worked under	canola	0	0
2002-35-4	canola	0	0	w.wheat		worked under	canola	0	0
2002-36-1	canola	0	0	wheat		0/21863	canola	0	0
2002-36-2	canola	0	0	wheat		0/17961	canola	0	0
2002-36-3	canola	0	0	wheat		0/17688	canola	0	0
2002-36-4	canola	0	0	wheat		0/20389	canola	0	0
2002-37-1	peas	0	0	peas	0	0	canola	0	0
2002-37-2	peas	0	0	peas	0	0	canola	0	0
2002-37-3	peas	0	0	peas	0	0	canola	0	0
2002-37-4	peas	0	0	peas	0	0	canola	0	0
2002-38-1	canola	0	0	barley	0	0	canola	0	0
2002-38-2	canola	0	0	barley	0	0	canola	0	0
2002-38-3	canola	0	0	barley	0	0	canola	0	0
2002-38-4	canola	0	0	barley	0	0	canola	0	0
2002-39-1	lentils	0	0	alfalfa	0	0	canola	0	0
2002-39-2	lentils	0	0	alfalfa	0	0	canola	0	0
2002-39-3	lentils	0	0	alfalfa	0	0	canola	0	0
2002-39-4	lentils	0	0	alfalfa	0	0	canola	0	0
2002-40-1	peas	0	0	barley	0	0	canola	0	0
2002-40-2	peas	0	0	barley	0	0	canola	0	0
2002-40-3	peas	0	0	barley	0	0	canola	0	0
2002-40-4	peas	0	0	barley	3	0	canola	0	0
2002-41-1	canola	0	0	wheat		0/13726	canola	0	0
2002-41-2	canola	0	0	wheat		0/18969	canola	0	0
2002-41-3	canola	0	0	wheat		0/14850	canola	0	0
2002-41-4	canola	0	0	wheat		0/23954	canola	0	0
2002-42-1	peas	0	0	wheat		0/21828	flax	0	0
2002-42-2	peas	0	0	wheat		0/21150	flax	0	0
2002-42-3	peas	0	0	wheat		0/26166	flax	0	0
2002-42-4	peas	0	0	wheat		0/12907	flax	0	0
2002-43-1	canola	0	0	canaryseed	0	0	canola	0	0
2002-43-2	canola	0	0	canaryseed	0	0	canola	0	0
2002-43-3	canola	0	0	canaryseed	0	0	canola	0	0
2002-43-4	canola	0	0	canaryseed	0	0	canola	0	0
2002-44-1	canola	0	0	barley	0	0	peas	0	0
2002-44-2	canola	0	0	barley	0	0	peas	0	0
2002-44-3	canola	0	0	barley	0	0	peas	0	0
2002-44-4	canola	0	0	barley	1	0	peas	0	0
2002-45-1	canola	0	0	wheat		0/17451	wheat		0/21187
2002-45-2	canola	0	0	wheat		0/23004	wheat		0/18833
2002-45-3	canola	0	0	wheat		0/24219	wheat		0/17490
2002-45-4	canola	0	0	wheat		0/22478	wheat		0/14268
2002-46-1	barley	3	0	wheat		0/29139	canola	0	0
2002-46-2	barley	1	0	wheat		0/8518	canola	0	0
2002-46-3	barley	2	0	wheat		0/22205	canola	0	0
2002-46-4	barley	3	0	wheat		0/28852	canola	0	0
2002-47-1	barley	2	0	barley	0	0	canola	0	0
2002-47-2	barley	4	0	barley	0	0	canola	0	0

2002-47-3	barley	1	0	barley	0	0	canola	0	0
2002-47-4	barley	3	0	barley	0	0	canola	0	0
2002-48-1	canola	0	0	triticale	0	0	canola	0	0
2002-48-2	canola	0	0	triticale	0	0	canola	0	0
2002-48-3	canola	0	0	triticale	0	0	canola	0	0
2002-48-4	canola	0	0	triticale	0	0	canola	0	0
2002-49-1	barley	9	0	canola	0	0	barley	0	0
2002-49-2	barley	10	0	canola	0	0	barley	0	0
2002-49-3	barley	10	0	canola	0	0	barley	0	0
2002-49-4	barley	12	0	canola	0	0	barley	0	0
2002-50-1	barley	3	0	barley	0	0	canola	0	0
2002-50-2	barley	2	0	barley	0	0	canola	0	0
2002-50-3	barley	0	0	barley	0	0	canola	0	0
2002-50-4	barley	4	0	barley	0	0	canola	0	0
2002-51-1	canola	0	0	triticale	0	0	canola	0	0
2002-51-2	canola	0	0	triticale	0	0	canola	0	0
2002-51-3	canola	0	0	triticale	0	0	canola	0	0
2002-51-4	canola	0	0	triticale	0	0	canola	0	0
2002-52-1	canola	0	0	wheat		0/16542	canola	0	0
2002-52-2	canola	0	0	wheat		0/20339	canola	0	0
2002-52-3	canola	0	0	wheat		0/22462	canola	0	0
2002-52-4	canola	0	0	wheat		0/27659	canola	0	0
2002-53-1	peas	0	0	peas	0	0	canola	0	0
2002-53-2	peas	0	0	peas	0	0	canola	0	0
2002-53-3	peas	0	0	peas	0	0	canola	0	0
2002-53-4	peas	0	0	peas	0	0	canola	0	0
2002-54-1	canola	0	0	triticale	0	0	canola	0	0
2002-54-2	canola	0	0	triticale	0	0	canola	0	0
2002-54-3	canola	0	0	triticale	0	0	canola	0	0
2002-54-4	canola	0	0	triticale	0	0	canola	0	0
2002-55-1	wheat		0/11398	canola	0	0	wheat		0/17171
2002-55-2	wheat		0/12298	canola	0	0	wheat		0/19738
2002-55-3	wheat		0/12327	canola	0	0	wheat		0/15663
2002-55-4	wheat		0/11069	canola	0	0	wheat		0/19329
2002-56-1	oats	0	0	canola	0	0	barley	0	0
2002-56-2	oats	0	0	canola	0	0	barley	0	0
2002-56-3	oats	0	0	canola	0	0	barley	0	0
2002-56-4	oats	0	0	canola	0	0	barley	0	0
2002-57-1	wheat		0/8872	oats	0	0	barley	9	0
2002-57-2	wheat		0/8043	oats	0	0	barley	5	0
2002-57-3	wheat		0/7217	oats	0	0	barley	1	0
2002-57-4	wheat		0/10674	oats	0	0	barley	12	0
2002-58-1	canola	0	0	wheat		0/9586	wheat		0/14593
2002-58-2	canola	0	0	wheat		0/12810	wheat		0/18214
2002-58-3	canola	0	0	wheat		0/23303	wheat		0/15497
2002-58-4	canola	0	0	wheat		0/12912	wheat		0/16933
2002-59-1	canola	0	0	triticale	0	0	canola	0	0
2002-59-2	canola	0	0	triticale	0	0	canola	0	0
2002-59-3	canola	0	0	triticale	0	0	canola	0	0
2002-59-4	canola	0	0	triticale	0	0	canola	0	0

2002-60-1	canola	0	0	wheat		0/17779	barley	18	0
2002-60-2	canola	0	0	wheat		0/14920	barley	18	0
2002-60-3	canola	0	0	wheat		0/11412	barley	29	0
2002-60-4	canola	0	0	wheat		0/12312	barley	6	0
2002-61-1	barley	11	0	canola	0	0	peas	0	0
2002-61-2	barley	14	0	canola	0	0	peas	0	0
2002-61-3	barley	14	0	canola	0	0	peas	0	0
2002-61-4	barley	17	0	canola	0	0	peas	0	0
2002-62-1	canola	0	0	wheat		0/19580	canola	0	0
2002-62-2	canola	0	0	wheat		0/20653	canola	0	0
2002-62-3	canola	0	0	wheat		0/17774	canola	0	0
2002-62-4	canola	0	0	wheat		0/11052	canola	0	0
2002-63-1	canola	0	0	wheat		0/11280	canola	0	0
2002-63-2	canola	0	0	wheat		0/15561	canola	0	0
2002-63-3	canola	0	0	wheat		0/7414	canola	0	0
2002-63-4	canola	0	0	wheat		0/17758	canola	0	0
2002-64-1	canola	0	0	wheat		0/14307	canola	0	0
2002-64-2	canola	0	0	wheat		0/11536	canola	0	0
2002-64-3	canola	0	0	wheat		0/12322	canola	0	0
2002-64-4	canola	0	0	wheat		0/16565	canola	0	0
2002-65-1	barley	8	0	wheat		0/13315	canola	0	0
2002-65-2	barley	20	0	wheat		0/14906	canola	0	0
2002-65-3	barley	14	0	wheat		0/18296	canola	0	0
2002-65-4	barley	16	0	wheat		0/12875	canola	0	0
2002-66-1	canola	0	0	canola	0	0	barley	0	0
2002-66-2	canola	0	0	canola	0	0	barley	0	0
2002-66-3	canola	0	0	canola	0	0	barley	0	0
2002-66-4	canola	0	0	canola	0	0	barley	0	0
2002-67-1	peas	0	0	wheat		0/19142	canola	0	0
2002-67-2	peas	0	0	wheat		0/20589	canola	0	0
2002-67-3	peas	0	0	wheat		0/23717	canola	0	0
2002-67-4	peas	0	0	wheat		0/23727	canola	0	0
2002-68-1	peas	0	0	wheat		0/27874	peas	0	0
2002-68-2	peas	0	0	wheat		0/20206	peas	0	0
2002-68-3	peas	0	0	wheat		0/17778	peas	0	0
2002-68-4	peas	0	0	wheat		0/21545	peas	0	0
2002-69-1	barley	16	0	canola	0	0	peas	0	0
2002-69-2	barley	15	0	canola	0	0	peas	0	0
2002-69-3	barley	18	0	canola	0	0	peas	0	0
2002-69-4	barley	17	0	canola	0	0	peas	0	0
2002-70-1	barley	2	0	wheat		0/21516	oats	0	0
2002-70-2	barley	13	0	wheat		0/15540	oats	0	0
2002-70-3	barley	5	0	wheat		0/20992	oats	0	0
2002-70-4	barley	7	0	wheat		0/15415	oats	0	0
2002-71-1	peas	0	0	wheat		0/21394	canola	0	0
2002-71-2	peas	0	0	wheat		0/23003	canola	0	0
2002-71-3	peas	0	0	wheat		0/20735	canola	0	0
2002-71-4	peas	0	0	wheat		0/21553	canola	0	0
2002-72-1	canola	0	0	wheat		0/11456	canola	0	0
2002-72-2	canola	0	0	wheat		0/16273	canola	0	0

2002-72-3	canola	0	0	wheat		0/15037	canola	0	0
2002-72-4	canola	0	0	wheat		0/14540	canola	0	0
2002-73-1	canola	0	0	wheat		0/24050	canola	0	0
2002-73-2	canola	0	0	wheat		0/25206	canola	0	0
2002-73-3	canola	0	0	wheat		0/18562	canola	0	0
2002-73-4	canola	0	0	wheat		0/18176	canola	0	0
2002-74-1	canola	0	0	barley	0	0	wheat		0/7152
2002-74-2	canola	0	0	barley	0	0	wheat		0/17146
2002-74-3	canola	0	0	barley	8	0	wheat		0/15728
2002-74-4	canola	0	0	barley	0	0	wheat		0/16377
2002-75-1	wheat		0/16168	fall rye	0	0	canola	0	0
2002-75-2	wheat		0/22935	fall rye	0	0	canola	0	0
2002-75-3	wheat		0/20371	fall rye	0	0	canola	0	0
2002-75-4	wheat		0/14502	fall rye	0	0	canola	0	0
2002-76-1	canola	0	0	peas	0	0	oats	0	0
2002-76-2	canola	0	0	peas	0	0	oats	0	0
2002-76-3	canola	0	0	peas	0	0	oats	0	0
2002-76-4	canola	0	0	peas	0	0	oats	0	0

Table 6. Survey of 2003 pollen recipient fields for wheat volunteers in 2004, 2005 and 2006

2003 Field	2004 Crop	In-field volunteer wheat count no. spikes	Blue aleurone Seeds no./total	2005 Crop	In-field volunteer wheat count no. spikes	Blue aleurone Seeds no./total	2006 Crop	In-field volunteer wheat count no. spikes	Blue aleurone Seeds no./total
2003-P38-center	peas	0	0	canola	0	0	wheat	2	28/29781
2003-P38-NE	peas	0	0	canola	0	0	wheat		0/28894
2003-P38-SE	peas	0	0	canola	0	0	wheat		0/26992
2003-P38-SW	peas	0	0	canola	0	0	wheat		0/30463
2003-P38-NW	peas	0	0	canola	0	0	wheat		0/28616
2003-1-1	peas	0	0	canola	0	0	wheat		0/20126
2003-1-2	peas	0	0	canola	0	0	wheat		0/27324
2003-1-3	peas	0	0	canola	0	0	wheat		0/25022
2003-1-4	peas	0	0	canola	0	0	wheat		0/32405
2003-2-1	canola	0	0	wheat		0/12136	canola	0	0
2003-2-2	canola	0	0	wheat		0/21972	canola	0	0
2003-2-3	canola	0	0	wheat		0/22592	canola	0	0
2003-2-4	canola	0	0	wheat		0/19520	canola	0	0
2003-3-1	summerfallow	0	0	barley	0	0	fallow	0	0
2003-3-2	summerfallow	0	0	barley	0	0	fallow	0	0
2003-3-3	summerfallow	0	0	barley	0	0	fallow	0	0
2003-3-4	summerfallow	0	0	barley	0	0	fallow	0	0
2003-4-1	wheat		0/12829	canola/barley	0	0	fallow	0	0
2003-4-2	wheat		0/14524	canola/barley	0	0	fallow	0	0
2003-4-3	wheat		0/13066	canola/barley	0	0	fallow	0	0
2003-4-4	wheat		0/20686	canola/barley	0	0	fallow	0	0
2003-5-1	lentils	31	0	barley	0	0	canola	0	0
2003-5-2	lentils	70	0	barley	0	0	canola	0	0
2003-5-3	lentils	34	0	barley	0	0	canola	0	0
2003-5-4	lentils	81	0	barley	22	0	canola	0	0
2003-6-1	canola	0	0	wheat		0/16436	canola	0	0
2003-6-2	canola	0	0	wheat		0/24240	canola	0	0
2003-6-3	canola	0	0	wheat		0/16144	canola	0	0
2003-6-4	canola	0	0	wheat		0/21325	canola	0	0
2003-7-1	canola	0	0	wheat		0/17159	fallow	0	0
2003-7-2	canola	0	0	wheat		0/16955	fallow	0	0
2003-7-3	canola	0	0	wheat		0/13098	fallow	0	0
2003-7-4	canola	0	0	wheat		0/19548	fallow	0	0
2003-8-1	flax	0	0	canola	0	0	wheat		0/19890
2003-8-2	flax	34	0	canola	0	0	wheat		0/17453
2003-8-3	flax	44	0	canola	0	0	wheat		0/17097
2003-8-4	flax	14	0	canola	0	0	wheat		0/18105
2003-9-1	barley	10	0	canola	0	0	barley	0	0
2003-9-2	barley	6	0	canola	0	0	barley	0	0
2003-9-3	barley	14	0	canola	0	0	barley	0	0
2003-9-4	barley	0	0	canola	0	0	barley	0	0

2003-10-1	barley	27	0	canola	0	0	wheat		0/38609
2003-10-2	barley	34	0	canola	0	0	wheat		0/35268
2003-10-3	barley	99	0	canola	0	0	wheat		0/30244
2003-10-4	barley	28	0	canola	0	0	wheat		0/40220
2003-11-1	peas	0	0	wheat		0/26420	canola	0	0
2003-11-2	peas	0	0	wheat		0/10495	canola	0	0
2003-11-3	peas	0	0	wheat		0/7071	canola	0	0
2003-11-4	peas	0	0	wheat		0/10429	canola	0	0
2003-12-1	lentils	35	0	barley	4	0	canola	0	0
2003-12-2	lentils	6	0	barley	7	0	canola	0	0
2003-12-3	lentils	7	0	barley	5	0	canola	0	0
2003-12-4	lentils	6	0	barley	18	0	canola	0	0
2003-13-1	summerfallow	0	0	barley	0	0	canola	0	0
2003-13-2	summerfallow	0	0	barley	0	0	canola	0	0
2003-13-3	summerfallow	0	0	barley	0	0	canola	0	0
2003-13-4	summerfallow	0	0	barley	0	0	canola	0	0
2003-14-1	canola	0	0	barley	0	0	canola	0	0
2003-14-2	canola	0	0	barley	0	0	canola	0	0
2003-14-3	canola	0	0	barley	0	0	canola	0	0
2003-14-4	canola	0	0	barley	0	0	canola	0	0
2003-15-1	lentils swathed	0	0	fallow	0	0	w.wheat		0/19079
2003-15-2	lentils swathed	0	0	fallow	0	0	fallow	0	0
2003-15-3	lentils swathed	0	0	fallow	0	0	w.wheat		0/22893
2003-15-4	lentils swathed	0	0	fallow	0	0	w.wheat		0/22814
2003-16-1	barley	0	0	canola	0	0	barley	0	0
2003-16-2	barley	158	0	canola	0	0	barley	0	0
2003-16-3	barley	0	0	canola	0	0	barley	0	0
2003-16-4	barley	44	0	canola	0	0	barley	0	0
2003-17-1	canola	0	0	wheat		0/16494	fallow	0	0
2003-17-2	canola	0	0	wheat		0/19674	fallow	0	0
2003-17-3	canola	0	0	wheat		0/14981	fallow	0	0
2003-17-4	canola	0	0	wheat		0/13354	fallow	0	0
2003-18-1	canola	0	0	barley	0	0	oats	0	0
2003-18-2	canola	0	0	barley	0	0	oats	0	0
2003-18-3	canola	0	0	barley	0	0	oats	0	0
2003-18-4	canola	0	0	barley	0	0	oats	0	0
2003-19-1	wheat		0/8021	canola	0	0	fallow	0	0
2003-19-2	flax	3	0	canola	0	0	wheat		0/19048
2003-19-3	flax	52	0	canola	0	0	wheat		0/18472
2003-19-4	flax	69	0	canola	0	0	wheat		0/19197
2003-20-1	wheat		0/24948	canola	0	0	fallow	0	0
2003-20-2	wheat		0/13193	canola	0	0	fallow	0	0
2003-20-3	wheat		0/17189	canola	0	0	fallow	0	0
2003-20-4	wheat		0/12984	canola	0	0	fallow	0	0
2003-21-1	canola	0	0	barley	0	0	fallow	0	0
2003-21-2	canola	0	0	barley	0	0	fallow	0	0
2003-21-3	canola	0	0	barley	0	0	fallow	0	0
2003-21-4	canola	0	0	barley	0	0	fallow	0	0
2003-22-1	canola	0	0	barley	0	0	canola	0	0
2003-22-2	canola	0	0	barley	0	0	canola	0	0

2003-22-3	canola	0	0	barley	0	0	canola	0	0
2003-22-4	canola	0	0	barley	0	0	canola	0	0
2003-23-1	wheat		0/20873	canola	0	0	fallow	0	0
2003-23-2	wheat		0/8353	canola	0	0	fallow	0	0
2003-23-3	wheat		0/18622	canola	0	0	fallow	0	0
2003-23-4	wheat		0/13017	canola	0	0	fallow	0	0
2003-24-1	oats	0	0	barley	1	0	peas	0	0
2003-24-2	oats	0	0	barley	13	0	peas	0	0
2003-24-3	oats	0	0	barley	7	0	peas	0	0
2003-24-4	oats	0	0	barley	5	0	peas	0	0
2003-25-1	canola	0	0	barley	0	0	wheat		0/22803
2003-25-2	canola	0	0	barley	0	0	wheat		0/28121
2003-25-3	canola	0	0	barley	0	0	wheat		0/30913
2003-25-4	canola	0	0	barley	0	0	wheat		0/26535
2003-26-1	oats	0	0	barley	0	0	canola	0	0
2003-26-2	oats	0	0	barley	6	0	canola	0	0
2003-26-3	oats	0	0	barley	0	0	canola	0	0
2003-26-4	oats	0	0	barley	0	0	canola	0	0
2003-27-1	oats	0	0	barley	0	0	canola	0	0
2003-27-2	oats	0	0	barley	0	0	canola	0	0
2003-27-3	oats	0	0	barley	0	0	canola	0	0
2003-27-4	oats	0	0	barley	0	0	canola	0	0
2003-28-1	canola	0	0	barley	0	0	peas	0	0
2003-28-2	canola	0	0	barley	0	0	peas	0	0
2003-28-3	canola	0	0	barley	0	0	peas	0	0
2003-28-4	canola	0	0	barley	0	0	peas	0	0
2003-29-1	canola	0	0	barley	0	0	wheat		0/13496
2003-29-2	canola	0	0	barley	0	0	wheat		0/14768
2003-29-3	canola	0	0	barley	0	0	wheat		0/16867
2003-29-4	canola	0	0	barley	0	0	wheat		0/13966
2003-30-1	canola	0	0	wheat		0/10268	fallow	0	0
2003-30-2	canola	0	0	wheat		0/13513	fallow	0	0
2003-30-3	canola	0	0	wheat		0/17051	fallow	0	0
2003-30-4	canola	0	0	wheat		0/13729	fallow	0	0
2003-31-1	canola	0	0	barley	14	0	slough	0	0
2003-31-2	canola	0	0	barley	10	0	slough	0	0
2003-31-3	canola	0	0	barley	9	0	slough	0	0
2003-31-4	canola	0	0	barley	0	0	slough	0	0
2003-32-1	canola	0	0	wheat		0/17016	fallow	0	0
2003-32-2	canola	0	0	wheat		0/13497	fallow	0	0
2003-32-3	canola	0	0	wheat		0/21772	fallow	0	0
2003-32-4	canola	0	0	wheat		0/14093	fallow	0	0
2003-33-1	canola	0	0	wheat		0/12718	canola	0	0
2003-33-2	canola	0	0	wheat		0/9960	canola	0	0
2003-33-3	canola	0	0	wheat		0/14480	canola	0	0
2003-33-4	canola	0	0	wheat		0/13555	canola	0	0
2003-34-1	lentils	0	0	barley	0	0	wheat		0/26931
2003-34-2	lentils	0	0	barley	0	0	wheat		0/21845
2003-34-3	lentils	0	0	barley	0	0	wheat		0/10950
2003-34-4	lentils	0	0	barley	0	0	wheat		0/17679

2003-35-1	canola	0	0	barley	5	0	wheat		0/20595
2003-35-2	canola	0	0	barley	11	0	wheat		0/21507
2003-35-3	canola	0	0	barley	0	0	wheat		0/23138
2003-35-4	canola	0	0	barley	0	0	wheat		0/26175
2003-36-1	canola	0	0	barley	0	0	wheat		0/20383
2003-36-2	canola	0	0	barley	0	0	wheat		0/24769
2003-36-3	canola	0	0	barley	18	0	wheat		0/24259
2003-36-4	canola	0	0	barley	0	0	wheat		0/18234
2003-37-1	lentils	0	0	wheat		0/21769	fallow	0	0
2003-37-2	lentils	0	0	wheat		0/20695	fallow	0	0
2003-37-3	lentils	0	0	wheat		0/17922	fallow	0	0
2003-37-4	lentils	0	0	wheat		0/15639	fallow	0	0
2003-38-1	lentils	0	0	canola	0	0	canola	0	0
2003-38-2	lentils	0	0	canola	0	0	canola	0	0
2003-38-3	lentils	0	0	canola	0	0	canola	0	0
2003-38-4	lentils	0	0	canola	0	0	canola	0	0
2003-39-1	lentils	0	0	barley	0	0	wheat		0/11683
2003-39-2	lentils	0	0	barley	0	0	wheat		0/18443
2003-39-3	lentils	0	0	barley	0	0	wheat		0/23460
2003-39-4	lentils	0	0	barley	0	0	wheat		0/20558
2003-40-1	canola	0	0	wheat		0/20105	peas	0	0
2003-40-2	canola	0	0	wheat		0/19100	peas	0	0
2003-40-3	canola	0	0	wheat		0/16906	peas	0	0
2003-40-4	canola	0	0	wheat		0/22194	peas	0	0
2003-41-1	canola	0	0	barley	2	0	canola	0	0
2003-41-2	canola	0	0	barley	3	0	canola	0	0
2003-41-3	canola	0	0	barley	6	0	canola	0	0
2003-41-4	canola	0	0	barley	8	0	canola	0	0
2003-42-1	lentils	0	0	canola	0	0	canola	0	0
2003-42-2	lentils	0	0	canola	0	0	canola	0	0
2003-42-3	lentils	0	0	canola	0	0	canola	0	0
2003-42-4	lentils	0	0	canola	0	0	canola	0	0
2003-43-1	peas	0	0	wheat		0/15728	flax	0	0
2003-43-2	peas	0	0	wheat		0/16172	flax	0	0
2003-43-3	peas	0	0	wheat		0/17090	flax	0	0
2003-43-4	peas	0	0	wheat		0/14431	flax	0	0
2003-44-1	peas	0	0	barley	0	0	fallow	0	0
2003-44-2	peas	0	0	barley	7	0	fallow	0	0
2003-44-3	peas	0	0	barley	0	0	fallow	0	0
2003-44-4	peas	0	0	barley	5	0	fallow	0	0
2003-45-1	canola	0	0	wheat		0/22433	fallow	0	0
2003-45-2	canola	0	0	wheat		0/19016	fallow	0	0
2003-45-3	canola	0	0	wheat		0/17943	fallow	0	0
2003-45-4	canola	0	0	wheat		0/21103	fallow	0	0
2003-46-1	peas	0	0	barley	1	0	wheat		0/17472
2003-46-2	peas	0	0	barley	0	0	wheat		0/17041
2003-46-3	peas	0	0	barley	0	0	wheat		0/20192
2003-46-4	peas	0	0	barley	0	0	wheat		0/19089
2003-47-1	canola	0	0	borage	18	0	wheat		0/19036
2003-47-2	canola	0	0	borage	13	0	wheat		0/21605

2003-47-3	canola	0	0	borage	27	0	wheat		0/21808
2003-47-4	canola	0	0	borage	9	0	wheat		0/21057
2003-48-1	canola	0	0	wheat		0/14877	canola	0	0
2003-48-2	canola	0	0	wheat		0/17795	canola	0	0
2003-48-3	canola	0	0	wheat		0/16988	canola	0	0
2003-48-4	canola	0	0	wheat		0/13847	canola	0	0
2003-49-1	summerfallow	0	0	barley		0	fallow	0	0
2003-49-2	summerfallow	0	0	barley		0	fallow	0	0
2003-49-3	summerfallow	0	0	barley		0	fallow	0	0
2003-49-4	summerfallow	0	0	barley		0	fallow	0	0
2003-50-1	summerfallow	0	0	wheat		0/15130	canola	0	0
2003-50-2	summerfallow	0	0	wheat		0/16997	canola	0	0
2003-50-3	summerfallow	0	0	wheat		0/20764	canola	0	0
2003-50-4	summerfallow	0	0	peas	0	0	canola	0	0
2003-51-1	barley	63	0	canola	0	0	wheat		0/35515
2003-51-2	barley	62	0	canola	0	0	wheat		0/38353
2003-51-3	barley	26	0	canola	0	0	wheat		0/37044
2003-51-4	barley	32	0	canola	0	0	wheat		0/39319
2003-52-1	canola	0	0	peas	0	0	canola	0	0
2003-52-2	canola	0	0	peas	0	0	canola	0	0
2003-52-3	canola	0	0	peas	0	0	canola	0	0
2003-52-4	canola	0	0	peas	0	0	canola	0	0
2003-53-1	canola	0	0	wheat		0/21260	wheat		0/14877
2003-53-2	canola	0	0	wheat		0/22504	wheat		0/19698
2003-53-3	canola	0	0	wheat		0/20264	wheat		0/19189
2003-53-4	canola	0	0	wheat		0/20992	wheat		0/23106
2003-54-1	canola	0	0	barley	28	0	canola	0	0
2003-54-2	canola	0	0	barley	31	0	canola	0	0
2003-54-3	canola	0	0	barley	15	0	canola	0	0
2003-54-4	canola	0	0	barley	11	0	canola	0	0
2003-55-1	canaryseed	0	0	lentils	0	0	barley	1	0
2003-55-2	canaryseed	0	0	lentils	0	0	barley	1	0
2003-55-3	canaryseed	0	0	lentils	0	0	barley	0	0
2003-55-4	canaryseed	0	0	lentils	0	0	barley	0	0
2003-56-1	canola	0	0	barley	9	0	canola	0	0
2003-56-2	canola	0	0	barley	6	0	canola	0	0
2003-56-3	canola	0	0	barley	0	0	canola	0	0
2003-56-4	canola	0	0	barley	9	0	canola	0	0
2003-57-1	canola	0	0	wheat		0/14210	canola	0	0
2003-57-2	canola	0	0	wheat		0/14324	canola	0	0
2003-57-3	canola	0	0	wheat		0/13333	canola	0	0
2003-57-4	canola	0	0	wheat		0/15398	canola	0	0
2003-58-1	canaryseed	0	0	lentils	0	0	barley	0	0
2003-58-2	canaryseed	0	0	lentils	0	0	barley	0	0
2003-58-3	canaryseed	0	0	lentils	0	0	barley	0	0
2003-58-4	canaryseed	0	0	lentils	0	0	barley	0	0
2003-59-1	canola	0	0	wheat		0/12151	fallow	0	0
2003-59-2	canola	0	0	wheat		0/17639	fallow	0	0
2003-59-3	canola	0	0	wheat		0/15148	fallow	0	0
2003-59-4	canola	0	0	wheat		0/14083	fallow	0	0

2003-60-1	summerfallow	0	0	canola	0	0	barley	0	0
2003-60-2	summerfallow	0	0	canola	0	0	fallow	0	0
2003-60-3	summerfallow	0	0	canola	0	0	fallow	0	0
2003-60-4	summerfallow	0	0	canola	0	0	fallow	0	0
2003-61-1	barley	1	0	canola	0	0	barley	5	0
2003-61-2	barley	4	0	canola	0	0	barley	14	0
2003-61-3	barley	4	0	canola	0	0	barley	6	0
2003-61-4	barley	5	0	canola	0	0	barley	18	0
2003-62-1	canola	0	0	wheat		0/16769	canola	0	0
2003-62-2	canola	0	0	wheat		0/16451	canola	0	0
2003-62-3	canola	0	0	wheat		0/14723	canola	0	0
2003-62-4	canola	0	0	wheat		0/17939	canola	0	0
2003-63-1	canola	0	0	barley	9	0	canola	0	0
2003-63-2	canola	0	0	barley	9	0	canola	0	0
2003-63-3	canola	0	0	barley	8	0	canola	0	0
2003-63-4	canola	0	0	barley	8	0	canola	0	0
2003-64-1	canola	0	0	barley	10	0	canola	0	0
2003-64-2	canola	0	0	barley	9	0	canola	0	0
2003-64-3	canola	0	0	barley	5	0	canola	0	0
2003-64-4	canola	0	0	barley	4	0	canola	0	0
2003-65-1	lentils	32	0	barley	16	0	canola	0	0
2003-65-2	lentils	33	0	barley	5	0	canola	0	0
2003-65-3	lentils	20	0	barley	5	0	canola	0	0
2003-65-4	lentils	31	0	barley	1	0	canola	0	0
2003-66-1	canola	0	0	wheat		0/16539	fallow	0	0
2003-66-2	canola	0	0	wheat		0/15004	fallow	0	0
2003-66-3	canola	0	0	wheat		0/21052	fallow	0	0
2003-66-4	canola	0	0	flooded			fallow	0	0
2003-67-1	canola	0	0	peas/barley	5	0	flooded	0	0
2003-67-2	canola	0	0	peas/barley	0	0	flooded	0	0
2003-67-3	canola	0	0	peas/barley	7	0	flooded	0	0
2003-67-4	canola	0	0	peas/barley	0	0	flooded	0	0
2003-68-1	peas	0	0	barley	0	0	fallow	0	0
2003-68-2	peas	0	0	barley	0	0	fallow	0	0
2003-68-3	peas	0	0	barley	0	0	fallow	0	0
2003-68-4	peas	0	0	barley	0	0	fallow	0	0
2003-69-1	barley	24	0	canola	0	0	barley	5	0
2003-69-2	barley	14	0	canola	0	0	barley	4	0
2003-69-3	barley	5	0	canola	0	0	barley	9	0
2003-69-4	barley	33	0	canola	0	0	barley	12	0
2003-70-1	peas	0	0	barley	0	0	fallow	0	0
2003-70-2	peas	0	0	barley	6	0	fallow	0	0
2003-70-3	peas	0	0	barley	9	0	fallow	0	0
2003-70-4	peas	0	0	barley	0	0	fallow	0	0
2003-71-1	barley	26	0	canola	0	0	wheat		0/33990
2003-71-2	barley	32	0	canola	0	0	wheat		0/29679
2003-71-3	barley	62	0	canola	0	0	wheat		0/30488
2003-71-4	barley	48	0	canola	0	0	wheat		0/35722
2003-72-1	barley	38	0	canola	0	0	wheat		0/25819
2003-72-2	barley	36	0	canola	0	0	wheat		0/28046

2003-72-3	barley	22	0	canola	0	0	wheat		0/30228
2003-72-4	barley	24	0	canola	0	0	wheat		0/34412
2003-73-1	canola	0	0	barley	0	0	fallow	0	0
2003-73-2	canola	0	0	barley	0	0	fallow	0	0
2003-73-3	canola	0	0	barley	0	0	fallow	0	0
2003-73-4	canola	0	0	barley	0	0	fallow	0	0
2003-74-1	canola	0	0	peas	0	0	canola	0	0
2003-74-2	canola	0	0	peas	0	0	canola	0	0
2003-74-3	canola	0	0	peas	0	0	canola	0	0
2003-74-4	canola	0	0	peas	0	0	canola	0	0
2003-75-1	canola	0	0	peas	0	0	canola	0	0
2003-75-2	canola	0	0	peas	0	0	canola	0	0
2003-75-3	canola	0	0	peas	0	0	canola	0	0
2003-75-4	canola	0	0	peas	0	0	canola	0	0
2003-76-1	canola	0	0	peas	0	0	wheat		0/31026
2003-76-2	canola	0	0	peas	0	0	wheat		0/34637
2003-76-3	canola	0	0	peas	0	0	wheat		0/33236
2003-76-4	canola	0	0	peas	0	0	wheat		0/26381

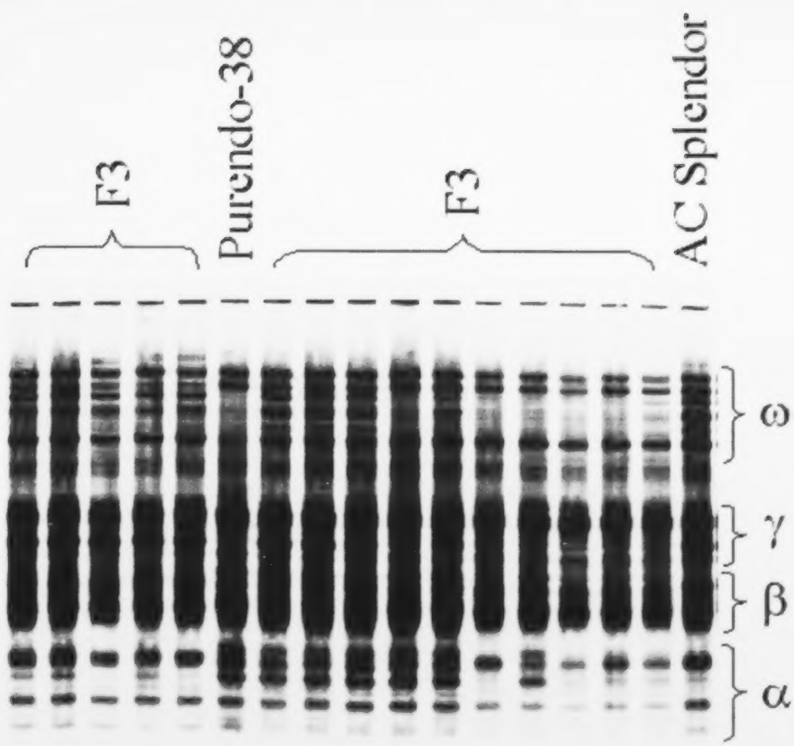

Fig. 1. Using A-PAGE, segregation of omega (ω), gamma (γ), beta (β), and alpha (α) gliadin banding patterns was detected among putative AC Splendor/Purendo-38 F_2-derived F_3 seeds when compared with the gliadin fingerprints of recipient parent AC Splendor (2003 Field #1) and pollen donor Purendo-38.